

# ANNALS of SURGERY

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# ANNALS *of* SURGERY

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## ACUTE INTESTINAL OBSTRUCTION

AN ANALYSIS OF TWO HUNDRED AND SIXTY-SIX CASES TREATED IN THE  
LOS ANGELES COUNTY GENERAL HOSPITAL \*

BY I. JACK VIDGOFF, M.D.

OF LOS ANGELES, CAL.

FROM THE SURGICAL SERVICE OF THE LOS ANGELES COUNTY GENERAL HOSPITAL

VERY little progress has been made in the last forty years in reducing the mortality of acute intestinal obstruction. In 1888, acute intestinal obstruction was a major subject of discussion at the American Association of Physicians and Surgeons. At that time the average mortality was 40 to 60 per cent. Twenty-five years later, acute intestinal obstruction was again discussed at the first annual session at the American College of Surgeons, the average mortality still being 40 to 60 per cent. Recent contributions still show the mortality to be practically unchanged, ranging from 36 per cent. in a series of cases by Finney<sup>1</sup> in 1921, to that of 60.9 per cent. in a series described by Miller<sup>2</sup> in 1929.

In spite of recently acquired laboratory aids and advanced diagnostic ability, we still lose approximately one-half of all patients having acute intestinal obstruction. This fact was the stimulation for undertaking this study of 266 cases. This report includes all cases of acute mechanical obstruction during the period of July, 1925, to July, 1930, which were admitted to the Los Angeles County General Hospital. The survey includes only definitely proven cases of acute mechanical obstruction, excluding adynamic ileus and cases of incarcerated hernia in which the bowel was not definitely occluded.

It must be remembered that these cases were usually seen by the family or neighborhood physician first, who referred 90 per cent. of these cases into the hospital. As a result, most cases have had a trial of "watchful waiting," and were sent into the hospital when an enema failed to return gas or faecal material. My purpose is not to discredit the family physician, for the delay is not his fault, as a rule. Many times it is the patient himself who refuses surgery, thinking that the condition is merely a "stomach-ache" and that a cathartic or an enema or some family remedy will bring relief. It is also often difficult for the family physician to make up his mind that a pain in the abdomen is the result of an intestinal obstruction. The picture is not always typical and many fatal cases were under observation by the surgeon after the patient was admitted to the hospital. Only when we realize that these cases should be operated upon even on suspicion will the mortality be reduced.

\* Read before the Surgical Staff of the Los Angeles County General Hospital, May 25, 1931.

It is interesting to note that 10 per cent. of the cases developed intestinal obstruction while under observation in the various wards of the hospital, and that the mortality of this group of cases was 10 per cent. higher than the general mortality. This further emphasizes the fact that it is not the fault alone of the family physician. There must be coöperation between the patient, the internist, and the surgeon. Even while the patient is observed in the ward there is still a tendency to procrastinate. The dictum of "sit tight" kills as many patients with intestinal obstruction as does morphine and cathartics.

*Incidence.*—There was one case of intestinal obstruction to practically every 400 patients admitted to the hospital during the five-year period. During this period there were 266 cases of acute intestinal obstruction with 122 deaths, an average mortality of 45.9 per cent.

In 1926 there were thirty-six cases with mortality of 33 per cent.

In 1927 there were forty-four cases with mortality of 55 per cent.

In 1928 there were seventy-eight cases with mortality of 36 per cent.

In 1929 there were sixty-six cases with mortality of 24.8 per cent.

In the half years of 1925 and that of 1930 there were forty-two cases with a mortality of 66 per cent. Because our medical audit department begin their year in July, it was necessary to take the cases accordingly. However, should the fiscal year be considered, our mortality has been gradually reduced to 25 per cent. in 1929.

*Factors Influencing Mortality.—The Incidence of Sex and Age.*—In this series, 47 per cent. of the patients were males with a mortality of 37.5 per cent., and 53 per cent. were females with a mortality of 44 per cent. The reason for the slightly larger percentage of females is probably due to the large amount of surgery done on the female generative organs with consequent adhesions. The ages varied from two days to eighty-one years. The average age recovered was 33.9 years while the average age died was 49.4 years. Sixty per cent. of the patients were between the ages of twenty to fifty years.

*Days in the Hospital.*—The average days in the hospital was 30.6 days for those who recovered and 5.1 days for those who died. This indicates that if the patient does not recover from intestinal obstruction, he usually succumbs in a short time. This has been observed frequently, many patients dying suddenly on the third or fourth post-operative day. The exact cause of this rather sudden death observed in these cases is not known. It was thought that it might be due to pulmonary embolism because of the manner of death, yet none of the cases coming to autopsy revealed any evidence of this lesion. It was also thought to be due to the sudden absorption of the toxic substances in the bowel after the obstruction was released. This, however, has been denied by many investigators.

*Time of Onset.*—The average length of time of onset of symptoms before the patient was admitted into the hospital was 2.6 days. This had a great influence on the high mortality. In 110 cases the onset was less than two days with 64 per cent. recovery. In 156 cases the onset was over two days

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with 44 per cent. recovery—a difference of 20 per cent. The shortest interval between the onset of symptoms and operation was seven hours. The shorter the interval the better is the chance for recovery. Finney had twenty-one cases which were operated within twelve hours or less with a mortality of 5 per cent. In the second twelve hours the mortality was 11 per cent., and in the second twenty-four hours it was 31 per cent. These statistics alone give us the reason for our large mortality rates and clearly show what Finney meant when he said, "Early diagnosis is the most important factor in the whole category."

*Symptoms and Signs.*—The clinical picture of intestinal obstruction is not as clear as text-book descriptions would imply. The symptoms depend upon the portion of the bowel involved. Generally speaking, the higher the obstruction, the more severe the symptoms and the graver the prognosis. The most common symptom and the one present in practically every case was abdominal pain. The pain associated with small bowel obstruction was paroxysmal, cramping, or knife-like and was associated with vigorous peristalsis. The pain associated with large bowel obstruction was less severe and less intermittent in character. During the paroxysm, the patient is usually doubled up and attempts to limit intestinal movement by limiting his respiration and by pressure of the hand on the abdomen. The pain is usually relieved by morphine. The pain is due to spasm of the smooth muscle and to the peristaltic effort on the part of the bowel to overcome the resistance at the point of obstruction.

Vomiting was present in 95 per cent. of the cases. Fæcal vomiting was observed in 13.6 per cent. of the patients with a mortality of 75 per cent. The higher the obstruction, the earlier the vomiting appeared. In low bowel obstruction, vomiting was a late symptom. The vomiting was not associated with the taking of food, and occurred, as a rule, with the paroxysms of pain. The exact cause of the vomiting is not known but its results have caused considerable discussion in regard to the acid-base equilibrium of the body. A majority of the observers agree that it accounts for the greater part of the dehydration, but are less prone to attribute the alkalosis which is present, at times, to the loss of the fluids.

Constipation was present in 60 per cent. of the cases. Diarrhoea was present in 8 per cent. of the cases. In 20 per cent. of the cases enemas had produced results, that is, a return of either fæcal matter or flatus. This is due to the fact that the bowel below the obstruction usually acts in a normal manner and may empty its contents. Once the bowel below the obstruction is empty, constipation is absolute. This absolute constipation, with pain and vomiting, form a triad of symptoms which should immediately put one on his guard and suspect intestinal obstruction.

Distension of the abdomen was present in 45 per cent. of the cases. Fever was absent as a rule. An elevation of temperature as observed in this series usually indicated either a peritonitis or pelvic abscess.

Rigidity of the abdominal muscles, as a rule, was absent. Instead, the abdomen was doughy and the coils of distended bowel could be palpated.

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Visible peristalsis was reported in only 5 per cent. of the cases, and was usually a late sign. Tenderness was present only in complicated cases and was associated with rigidity and temperature.

The average white cell count was 7900 with 79 per cent. polymorphonuclears. The counts averaged from 5400 to 28,000. The leucopaenia is the rule because of the toxæmia. Leucocytosis was found in late cases or in complicated cases due to a peritonitis.

Judging from the histories written by the surgical internes, intestinal obstruction could be diagnosed in over 80 per cent. of the cases. In some, a definite diagnosis was arrived at only with considerable difficulty. The other conditions with which intestinal obstruction may be confused are usually surgical, and the fact that a definite diagnosis is not made, should not deprive the patient the benefit of an immediate laparotomy. If there is sufficient reason to suspect the presence of an intestinal obstruction, waiting for the complete classical picture is unwarranted.

*Previous Operations.*—An interesting finding was the relative high percentage of cases which had previous abdominal or pelvic operations. In Miller's series 24.2 per cent. of the cases had had previous operations, and in Finney's series, 40 per cent. of the cases presented abdominal scars. In this series 68 per cent. had had previous abdominal operations. It was interesting to note the difference in mortality in those patients with previous abdominal operations as compared to those who had none. In 32 per cent. of cases not having previous abdominal operations, there was a mortality of 61.2 per cent., over 15 per cent. greater than the average mortality. This can be accounted for largely by the fact that obstruction was suspected sooner in the presence of an abdominal scar, again indicating, perhaps indirectly, the value of early diagnosis. The reason for the high mortality in cases without previous operations is also due to the fact that most of the cases were either carcinoma, which carried a high mortality on its own accord, or were unsuspected internal hernias. The latter were usually attended with high-grade and fulminating types of obstruction, more difficult of diagnosis.

A right rectus scar was most commonly observed. This was found in seventy-eight cases or 29.3 per cent. of the total number. Of these seventy-eight cases, 44.8 per cent. was the result of operations for ruptured appendicitis and had an attendant mortality of 54.3 per cent. This, incidentally, shows the ultimate results of acute appendicitis when not operated early.

A mid-line scar was present in seventy-two cases or approximately twenty-five of the total number. Of these seventy-two cases 62 per cent. involved operations on the female pelvic organs, and had a mortality of 42 per cent. In Finney's series the mortality following pelvic conditions was 60 per cent. This indicates how careful one should be in peritonizing all raw areas produced by operations on the pelvic organs in women.

The shortest time interval after the previous operation before the patient became obstructed was five hours. The longest was about twenty-seven years. In twenty-three cases (8.9 per cent.) obstruction developed within three weeks after operation. In 9 per cent. of the cases there had been

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previous operations for intestinal obstruction, the number of operations varying from two to twenty-eight.

*Anæsthesia.*—It was interesting to note the effect of various anæsthetics in regard to prognosis.

79.5 per cent. of the cases had ether with mortality of 41 per cent.

9.5 per cent. of the cases had spinal with mortality of 48 per cent.

11.0 per cent. of the cases had local with mortality of 89 per cent.

These figures are not to be taken as true indications of the relative merits of any type of anæsthetic. The moribund patients were operated under local and there was naturally a higher mortality. Many observers have noted the relatively lower mortality of general anæsthesia as compared to spinal or local. However, recent reports suggest that best results are to be obtained with spinal anaesthesia, and unless absolutely contra-indicated, spinal is the anaesthetic of choice. The average length of time of anaesthesia was one hour.

*The Rôle of the Flat Plate.*—The diagnosis was made largely on the basis of the history of the complaint and physical findings. The history is usually the most important factor. When the physical findings were classical it was usually in the later stages of the disease. Recently we have employed the use of the "flat plate" of the abdomen in confirming the diagnosis. The "flat plate" or "scout film" without use of contrast media, was first used by Schwartz in 1911. Case introduced the procedure in this country at about the same time. Recently Rabwin and Carter<sup>8</sup> reported a series of cases at the Los Angeles County General Hospital in which the "flat plate" was instrumental in confirming diagnosis and localizing the obstruction. Many of their cases are included in this series. The procedure is now routine in all cases in which intestinal obstruction is suspected. The actual time spent in preparing the patient and reading the film was about twenty minutes. The patients were given a milk and molasses enema to empty the bowel below the obstruction, and a film was then taken. This procedure causes the patient little if any distress. The film can be developed while the patient is being prepared for surgery, avoiding loss of time. In this series the "flat plate" was taken in 104, or approximately 39 per cent. of the cases. Of these the interpretations of the gas shadows lead to a positive diagnosis of intestinal obstruction in 71 per cent. The report as given out by the röntgenologic department was always guarded, stating that the picture was of an ileus, not differentiating it as to mechanical or adynamic.

The report was negative for obstruction in twenty-five cases. All of which were later found at operation to be completely obstructed. The negative findings in most of these cases were due to the fact that the bowel was filled with fluid which could not be seen on the "wet film."

It is evident that the diagnosis is not to be made by the use of the "flat plate" alone. The average case as seen by the family physician should not wait for the "flat plate" to be taken. In large hospitals such as this where X-ray service is available during twenty-four hours of the day, a "wet film" can be taken easily and in many cases is of distinct value. Its greatest value,

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however, is not so much as a diagnostic aid but in stimulating the surgeon to operate. If one is not sure of the diagnosis, the typical picture of the distended loops of gas-filled bowel on the film encourages the surgeon to believe that intestinal obstruction is present and urges him to operate immediately.

However, we must impress the average practitioner with the relative importance of the symptoms and signs of intestinal obstruction, rather than burden him with laboratory methods usually not available to him. The man who sees the patient first, usually the family physician, can do most in lowering the mortality of intestinal obstruction. For him the diagnosis must be simplified rather than complicated.

Checking over the histories with positive film reports, it was found that the diagnosis was made from the history and physical findings, and that the X-ray film merely made one more sure of the presence of intestinal obstruction. In scarcely any of the cases did the X-ray reveal anything unsuspected by clinical examination.

*Effect on Blood Chlorides.*—A complete blood chemistry was done in forty-six cases. Opinion is divided in regard to the rôle that blood chlorides play in prognosis. In this series the amount of blood chlorides present evidently played no part either in diagnosis nor prognosis. It is certainly unwise to withhold operation awaiting a blood chemistry report or preliminary administration of hypertonic chloride solution. The average blood chlorides in patients with intestinal obstruction who died were 390 milligrams per 100 cubic centimetres of blood. In those who recovered, the blood chlorides averaged 390.6 milligrams. Over one-half of the cases had a blood chloride of 450 milligrams or over. In several cases who died, the blood chlorides were as high as 550 milligrams and yet a high-grade obstruction with gangrene was present. It is interesting to note that the mortality in the cases given hypertonic saline was 65 per cent. This is probably explained by the fact that hypertonic saline was administered in the obviously bad cases. Normal saline was administered by hypodermoclysis in practically every case and was of distinct value in furnishing fluids.

*Causes of Obstruction.*—From the accompanying table (Table I) it is seen that the three most common causes of intestinal obstruction in this series were adhesions, hernia, and carcinoma respectively. In infants the most common cause was intussusception.

TABLE I

Type	Cases	Mortality
Adhesions .....	170	37.6 per cent.
Hernia .....	49	60.0 "
Cancer .....	22	68.0 "
Gall-stones .....	4	25.0 "
Intussusception .....	11	66.0 "
Volvulus of sigmoid .....	4	75.0 "
Meckel's diverticulum .....	2	None "
Diverticulitis .....	2	100 "

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The most frequent single cause of obstruction in this series was adhesions. There were 170 cases of obstruction due to adhesions with 106 recoveries, a mortality of 37.6 per cent. The lowest mortality was found in this group, the reason being that the presence of an abdominal scar usually hastened operation.

The next most common type of obstruction was hernia, forty-nine cases with a mortality of 60 per cent. The general mortality and the mortality of hernia would be much less had incarcerated hernia been included. The high mortality is due to the fact that only strangulated hernia was considered in this series. It is also of interest to note that there were fourteen cases of internal hernia due to congenital malformations with a mortality of but 50 per cent. These included hernia into the retrocaecal fossa,<sup>4</sup> hernia into the paraduodenal fossa, and other hernia due to malrotation of the gastro-intestinal tract. There were thirteen cases of strangulated inguinal hernia with a mortality of 66 per cent. In over one-half of these cases gangrene was present. The other forms of hernia found were femoral hernia with a mortality of 50 per cent., hernia through the obturator foramen, hernia through the broad ligament, ventral hernia, and a case of hernia through a gastro-enterostomy loop.

There were twenty-two cases of carcinoma with fifteen deaths, a mortality of 68 per cent. There were fourteen cases having carcinomas at the recto-sigmoid junction with a mortality of 64 per cent.

A word may be said about the less common causes of intestinal obstruction. There were eleven cases of intussusception with a mortality of 66 per cent. It was interesting to note that there were four cases of obstruction due to gall-stones with but one death. These cases were not toxic as a rule because gas probably escapes around the stone and prevents distension of the bowel and consequent interference with blood supply. The one fatal case died of a small perforation of the bowel with a resultant peritonitis. There were four cases of volvulus of the sigmoid with a 75 per cent. mortality, one case dying from another condition rather than obstruction. There were two cases of Meckel's diverticulum producing an obstruction, both recovering. There were also two cases of diverticulitis of the sigmoid with perforation and obstruction; both patients died.

Gangrene of the bowel was present in twenty-nine cases with a mortality of 90 per cent.

*Treatment.* Simple release of constricting bands or adhesions was done in 167 cases with a 50 per cent. mortality. Resection was done in twenty-nine cases with 80 per cent. mortality. In nine of these cases the Murphy button was used with five deaths, and in one case the button was the cause of a re-obstruction twenty-one days after the initial operation. End-to-end anastomosis was done in seven cases with six deaths. The side-to-side anastomosis was done in two cases with one death. The two loops of bowel were brought to the outside without anastomosis in six cases with five deaths. These figures show the

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results of late cases of intestinal obstruction, that is, with strangulation and interference of the blood supply to the bowel.

TABLE II

Procedure	Cases	Mortality
Release adhesions .....	167	50.0 per cent.
Resection .....	29	80.0 "
Enterostomies .....	40	79.8 "
Cæcostomy .....	10	80.0 "
Colostomy .....	5	60.0 "
Enterico-anastomosis .....	6	33.0 "
Enterotomy .....	4	25.0 "
Bowel stripped .....	5	40.0 "

Enterostomy was done in forty cases with a mortality of 79.8 per cent. This was usually done in late cases of obstruction. Many observers, notably Van Buren and Smith<sup>5</sup> also report high mortalities in cases in which enterostomy was done.

An enterostomy which drains the bowel is of distinct value in some instances. This is true particularly in cases of adynamic ileus rather than those of mechanical obstruction. There were two cases in particular, both children, who developed an adynamic ileus following a perforated appendicitis with peritonitis. Both these children were vomiting faecal matter and were very toxic. In both these cases a loop of bowel was brought into the wound, and the bowel snipped with a scissors. No anaesthetic was necessary, the procedure being carried out in the ward. Drainage was thereby established and the patients improved immediately. In one case the loop of bowel opened proved to be the jejunum, and the liquids taken by mouth would drain through the fistula. The child was not given fluids by mouth and after a rest period of four days the fistula healed completely of its own accord. Fluids were supplied by rectum, under the skin, and by the intravenous route. In the other child the loop of bowel opened was the ileum, and in this case complete healing did not occur so soon.

Unfortunately most enterostomies which are done in mechanical obstruction do not drain the bowel, and the catheters which are sutured into the bowel are either pulled out by the patients, or kink the bowel in such a way that there is practically no drainage. It is far better to operate these patients and release the obstruction, emptying the bowel immediately rather than inserting a tube and hope that it will produce drainage. Of course in extremely moribund patients there is nothing to do but to open the bowel and in these cases it is better to bring the loop of bowel to the wound and suture it there and then cut it, rather than use a catheter.

Cæcostomy was done in ten cases with a mortality of 80 per cent. Colostomy was done in five cases with 60 per cent. mortality. These were done in cases of carcinoma of the large bowel. Five of these patients survived the first stage, but died after the removal of the growth.

Enterico-anastomosis, short-circuiting loops of bowel, was done in six cases with a mortality of 33 per cent. Enterotomy was done in four cases with

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one death. The bowel was drained according to the Holden<sup>6</sup> technic in five cases with two deaths.

It is important in considering the treatment to differentiate incarceration from strangulation. When incarceration is present the patient is not toxic as a rule, and simple releasing of adhesions or short-circuiting operations may be all that is necessary. However, when there is distension of the bowel with consequent interference with the blood supply, and damaged intestinal mucosa, there is absorption of toxic contents of the bowel with resulting toxæmia. In these latter cases it is far better to drain the bowel of its contents, for simply releasing the obstruction will not relieve the patient.

### SUMMARY

(1) The mortality of intestinal obstruction can only be reduced when it is recognized early and operated early. The patient is often as much at fault as the physician and the surgeon, and greater coöperation between all three is necessary.

(2) The clinical picture is not always clear, and operation should not only be advised but insisted upon on suspicion that intestinal obstruction is present. To wait for the full clinical picture to develop will greatly reduce the patient's chances for recovery.

(3) The commonest cause of obstruction was adhesions. To eliminate these cases it is necessary to operate for acute appendicitis early and to fully peritonealize raw areas in pelvic operations.

(4) The "flat plate" while it is a distinct aid in urging the surgeon to operate is not essential in the diagnosis.

(5) There was apparently very little change in the blood chlorides in those patients who died in comparison to those who recovered. Patients did not do better with the administration of hypertonic saline as compared to normal saline. The fluids supplied was the important factor.

(6) Enterostomies do not lower the mortality except in some cases of adynamic ileus. If enterostomies are done they should drain the bowel on the table by cutting the bowel rather than using a catheter.

(7) Where there is interference with the blood supply to the bowel it is best to empty the contents of the bowel while the patient is on the table.

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## ACUTE INTESTINAL OBSTRUCTION AT THE NEW YORK HOSPITAL

A REPORT OF TWO HUNDRED AND THIRTY-FIVE CASES \*

BY NELSON W. CORNELL, M.D.

OF NEW YORK, N. Y.

THIS work is an analysis and report of all cases recorded in the New York Hospital under the diagnosis of acute intestinal obstruction between the years of 1913 and 1930. The material for this study was made possible through the courtesy of Dr. Eugene H. Pool, Director of the Second Surgical Division, and Dr. Charles L. Gibson, of the First Surgical Division, and their associates of the New York Hospital.

As Sir Frederick Treves<sup>1</sup> pointed out in his book on Intestinal Obstruction, the final outcome in these cases is not primarily dependent upon the actual stoppage to the flow of material along the intestinal tract, but rather upon the absorption of toxic products from the disordered intestine resulting in septic infection of the whole body. He states that: "The subjects of acute intestinal obstruction die for the most part with the phenomena of septic poisoning, and if a certain stage has been passed, the mere relieving of the obstruction does not save life." This last quotation sets forth clearly the serious aspects of this grave surgical condition.

The cause of death, in cases of acute obstruction, has been frequently discussed by clinicians and other investigators, and they have advanced many theories to explain it. Cooper<sup>2</sup> reviewed some 170 articles on intestinal obstruction and in his summary points out that in high obstruction there is (1) a profound disturbance in the acid-base mechanism resulting in alkalosis and dehydration, and also a definite toxæmia; (2) that there is a toxin in the lumen of the obstructed gut, which reaches the blood-stream, the origin of this toxin not being clear; (3) that there seems to be some mysterious connection between the toxæmia of high obstruction, acute pancreatitis, bilateral suprarenalectomy and anaphylaxis.

Sweet<sup>3</sup> believes that the principal organs concerned with the production of this toxin are the pancreas and the small intestine, especially the intestinal mucosa.

Ellis<sup>4</sup> states that this toxin is undoubtedly elaborated in the cells of the greater part of the mucosa of the small intestine, but chiefly in those of the duodenum. He also stresses the similarity between acute pancreatitis and high obstruction.

It may be stated, then, that in addition to the mere mechanical stoppage of intestinal flow, there is formed a toxin, presumably coming from the

\* Read May 1, 1931, before the Surgical Section of the New York Academy of Medicine.

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mucosa of the small intestine, which makes acute intestinal obstruction a most serious problem.

As this is a report of all cases analyzed, under the diagnosis of acute intestinal obstruction, no attempt will be made to adhere to any rigid classification, but rather the groups of cases will be discussed according to the pathological anatomy found. According to their frequency, these cases are grouped as follows:

Obstruction by:

(1) Bands, adhesions, <i>etc.</i> .....	110 cases
(2) Intussusception .....	36 cases
(3) Volvulus .....	16 cases
(4) Carcinoma of colon.....	16 cases
(5) Hernia .....	10 cases
	(Ext. 6
	(Int. 4
(6) Meckel's diverticulum .....	7 cases
(7) Gall-stones .....	4 cases
(8) Miscellaneous group .....	36 cases
	—
	235 cases
(a) Unknown cause .....	12
(b) Mesenteric thrombus .....	5
(c) Torsion of mesentery.....	1
(d) Paralytic ileus .....	6
(e) Tumor outside gut .....	3
(f) Congenital membrane .....	1
(g) Acute diverticulitis .....	1
(h) Polyp .....	1
(i) Sarcoma of colon.....	1
(j) Superior mesenteric artery.....	1
(k) Foreign body .....	1
(l) Megacolon .....	1
(m) Ulcerative colitis .....	1
(n) Impacted faeces .....	1

No effort was made in this series of cases to include anything not primarily diagnosed as acute intestinal obstruction. The few cases of strangulated hernia appearing were primarily diagnosed as acute intestinal obstruction, and the same holds true for the few cases of paralytic ileus which appear in the series.

*Diagnosis*—The symptoms and signs of acute intestinal obstruction make a familiar picture. The triad of symptoms, pain, vomiting, and obstipation, is still pathognomonic of acute obstruction. In this series of cases, on careful analysis of the patient's "chief complaint," it was found that pain was the symptom most frequently mentioned. Two hundred cases in this series mentioned pain as their foremost symptom. Three varieties of pain were recorded: first, the acute epigastric pain accompanied by nausea and vomiting, which follows the sudden twisting or strangulation of the abdominal viscera; secondly, dull pain referred to the site of the lesion; and,

thirdly, the intermittent spasms of pain caused by the peristaltic action of the gut as it meets an obstruction.

*Vomiting*—One hundred eighty-seven cases complained of vomiting. The usual history was that vomiting came on with the pain and continued through successive stages until the final stage of faecal vomiting was reached. Faecal vomiting usually means impending death and certainly should not be awaited to make sure of the diagnosis. In this series 60 cases were mentioned as definite faecal vomiting; 54 of these died, giving a mortality of 90 per cent.

*Obstipation*—In 152 cases this condition was found as one of the chief complaints. In nearly all cases attempts to obtain evacuation of the bowels by cathartic or enemata had been resorted to, without satisfactory result. Obtaining flatus by enema or colon irrigation in these obstructed cases is very often misleading. Gas may be obtained in rather large quantities from the large intestine, while the small intestine above it is completely obstructed. In New York Hospital we have come to disregard an irrigation or enema which reports "much flatus" unless it contains definite colored matter from the small gut.

It is readily seen then that in this series of cases, pain, vomiting, and obstipation deserve their legendary importance as the triad of symptoms so common to acute intestinal obstruction.

*Physical findings*—In these findings 172 cases were described as acutely ill. *Distention* was mentioned in 131 cases. *Tenderness* was found usually over the area of gut involved and gave a fairly accurate indication of the site of trouble, thus making the path of surgical approach more definite; it was mentioned in 147 cases. *Rigidity* was present in 60 cases, and *tympanites* in 7. A definite mass was felt in 51 cases; *free fluid* in the abdomen was diagnosed in 7 cases. *Visible peristalsis* frequently mentioned as a sign of acute obstruction was recorded in only nine cases. The reason for this is obvious, as visible peristalsis depends upon a chronic, incomplete obstruction with hypertrophy of the gut, while in most acute cases dilatation and not hypertrophy takes place. *Auscultation*, as pointed out by Deaver<sup>5</sup> and others, will give a very accurate idea of the condition of the bowels. He states that "Early in obstruction there is stormy hyperperistalsis occurring in waves, starting suddenly and ending abruptly, resembling ocean waves during a storm." Hypoperistalsis indicates that the gut is rapidly going on to complete obstruction and paralysis. The last stage, where no peristaltic waves are heard, but an occasional tinkling, indicates complete bowel paralysis.

The temperature in this series of cases averaged 100°, with an average high level of 103°, and an average low level of 97.6°. The pulse averaged 100 a minute, with an average high of 146 and average low of 74. The respirations averaged 25 per minute, with an average high of 38 and average low of 19.

*Laboratory findings*—The leucocyte counts were reported in 157 cases.

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The average was 15,445 white blood cells, with 80 per cent. polymorphonuclears. The highest total count was 26,240 with 91 per cent. polymorphonuclears, while the lowest count recorded was 5,940 with 62 per cent. polymorphonuclears.

The urine was reported in 136 cases before operation. In 129 cases the urine was acid, 7 cases of alkaline, 99 cases showed albumen, 7 cases sugar, 32 showed casts, 24 acetone and 11 diacetic acid.

The blood pressure was recorded in only 23 cases before operation, the systolic pressure averaging 100, the diastolic 88.

Blood chemistry, in the small number of cases recorded, showed an increase in the blood sugar and urea nitrogen.

*Röntgen-ray examination*—Barium or other opaque meals should never be given in cases suspected of even partial obstruction for two obvious reasons: First, barium, in the majority of incomplete obstruction cases, will make the obstruction complete; and, secondly, in the event of subsequent operation and manipulation of the intestines, it will be regurgitated and aspirated, which will cause immediate death from suffocation. On the other hand, a plain plate of the abdomen in acute obstruction may be very helpful in the early stages. By this is meant the "step-ladder" appearance which the small intestine, when distended with gas, gives in the plain plate. Wangensteen and Lynch<sup>6</sup> in experimental work on dogs, found that enough gas collected in the small intestine in four to five hours after occlusion to give a definite X-ray shadow and make possible the early diagnosis of a block in the intestine. In twenty to twenty-four hours distention was fairly general even though the clinical distention was absent. Rabwin and Carter<sup>7</sup> in an article on the clinical aspects of plain X-ray diagnosis reported, at first, the "herring-bone" appearance of the small intestine and as the distention progressed further, the step-ladder type of picture developed. (See Fig. 1.) They believed that because of the free use of plain X-ray examination in their cases of intestinal obstruction, they were coming to operation earlier and their mortality was definitely lowered. Later, the plain plate shows different gas-fluid levels which is quite diagnostic. (See Figs. 2 and 3.) These phenomena appear relatively late in the acute obstruction, that is, after the bowels are badly paralyzed and distended, and are therefore not as important as the typical gaseous distention described above. Nineteen cases are recorded in this series as positive for gaseous distention of the small intestine and all were proven by operation to be obstructed. It is now the policy at the New York Hospital to take plain plates of every case suspected of acute obstruction.

No pre-operative diagnosis of obstruction was recorded in 58 cases which later proved to be acutely obstructed. An incorrect diagnosis was made in 33 cases. In this latter group the diagnosis of acute appendicitis was made 19 times, perforated peptic ulcer 3 times. The other 12 cases were distributed as follows: ectopic gestation 1, renal colic 1, twisted ovarian cyst 1, acute pelvic inflammatory disease 2, polyposis colon 1, hernia 2, pancreatitis

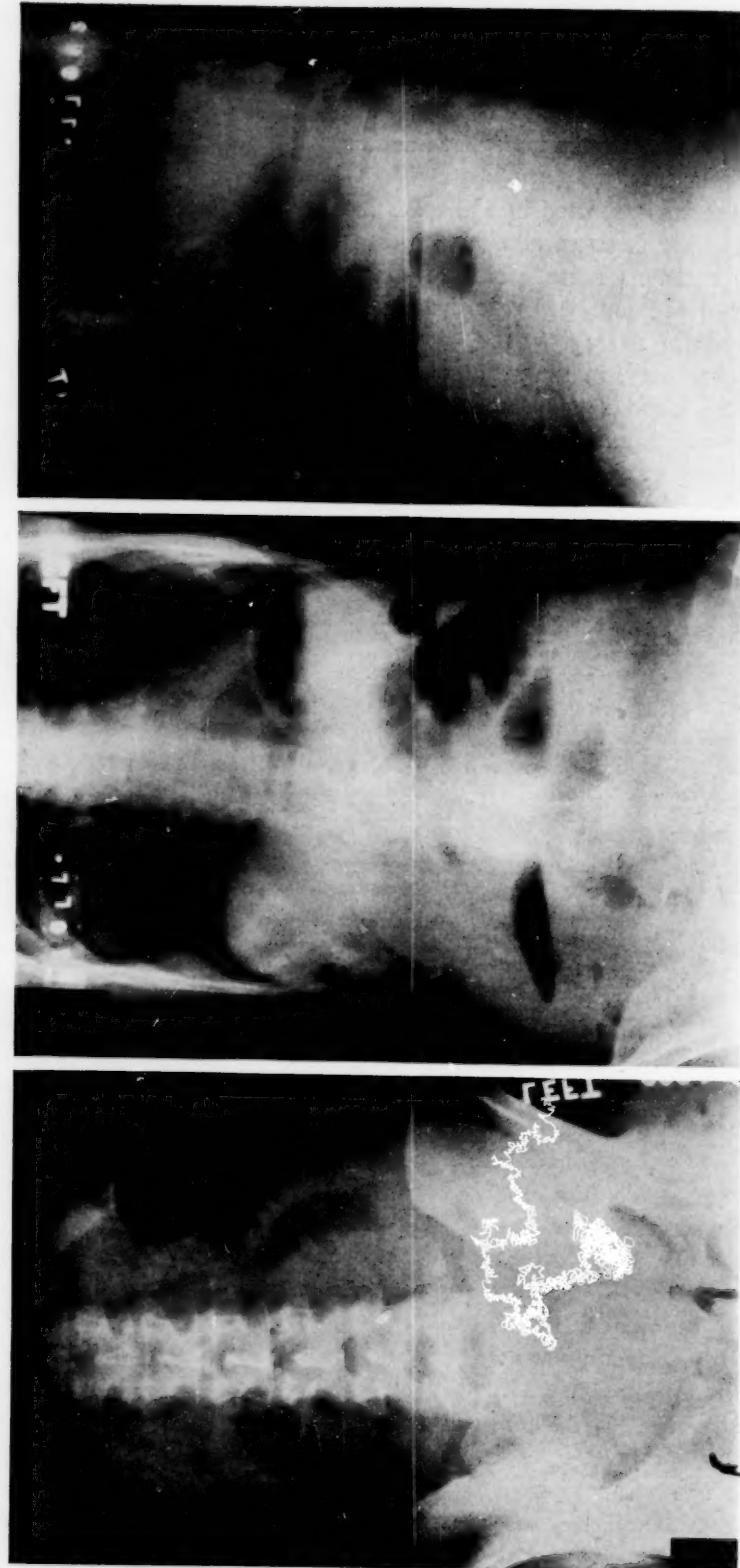


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 1.—Plain X-ray plate of abdomen showing early distension of the gut by gas.  
FIGS. 2 and 3.—Plain X-ray plates of abdomen showing different gas fluid levels in an obstructed case.

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1, carcinoma of colon 1, diverticulitis of colon 1, and acute gall-bladder disease 1. It would appear, then, that acute intestinal obstruction can be confused with practically any abdominal surgical condition.

CHART I

MORTALITY BY HOURS AND BY CAUSAL AGENT

HOURS	1-12		12-24		24-48		48-72		72-96		96-120		All Others			
	No. of Died Cases	Total Died Cases	Mortality													
Bands	7	1	14	14	28	12	17	7	10	3	10	51	45.45			
Intussusception	9	3	14	2	3	3	6	5	2	2	2	0	36	17		
Volvulus	5	0	0	0	4	3	2	0	2	1	1	2	1	43.75		
Meckel's Diverticulum	1	0	2	1	3	3	0	0	0	0	0	1	0	7	4	
Gall Stones	1	1	0	0	0	0	3	2	0	0	0	0	0	4	3	
External Hernia	0	0	2	1	1	0	2	0	0	0	1	0	6	2	33.33	
Internal Hernia	0	0	3	1	0	0	0	0	0	0	1	0	0	4	1	
Ca. of Colon	1	1	2	1	2	2	2	4	4	1	0	4	2	16	12	
Miscellaneous	4	2	8	2	8	5	5	3	4	4	3	2	8	7	36	24
Total	26	8	52	22	49	28	37	19	22	15	19	31	29	18	235	120

*Age incidence*—The average age was thirty-two years. The oldest case was ninety years and the youngest thirty-four hours. *Sex*—There were 118 males and 117 females, a very even division of sex. *Civil state*—One hun-

CHART II

MORTALITY BY OPERATIONS

	Resection of Small Intestine		Resection of Large Intestine		Colostomy		Primary Enterostomy		Secondary Enterostomy		Release of Obstruction		
	Lived	Died	Lived	Died	Lived	Died	Lived	Died	Lived	Died	Lived	Died	
Bands	4	6	0	2	2	2	4	3	16	1	1	51	15
Intussusception	0	3	0	1	0	2	1	2	1	1	1	17	10
Volvulus	0	0	2	0	2	4	0	0	0	0	0	3	2
Meckel's Diverticulum	0	0	0	0	0	0	0	0	0	0	0	2	4
Gall Stones	0	0	0	0	0	0	0	0	1	0	1	1	1
External Hernia	0	1	0	0	0	0	0	0	1	0	0	3	0
Internal Hernia	0	1	0	0	0	0	0	0	0	0	0	2	1
Ca. of Colon	0	0	2	3	1	4	0	2	1	1	0	1	1
Miscellaneous	1	1	1	2	0	2	3	5	1	2	4	6	6
Total	5	12	5	8	5	16	7	27	4	6	83	40	
Mortality	70.58		61.53		76.19		82.00		60.00		32.52		

(Chart #2)

dred twenty-nine cases were married or had been married, while 106 were single. The general mortality rate was 51.48 per cent. The average duration of symptoms before operation was 3.9 days. This last figure, of course, is high for a general average of a large group of cases, when it is well known that the time factor may make the difference between a simple

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successful operation for relief of the obstruction, or a hopelessly toxic patient who will die in spite of any surgical procedures instituted. (See Chart I.) It should be emphasized that 50 per cent. of the present mortality rate can be attributed to the delay from the prolonged treatment by enemas, stupes and cathartics, by the doctor who first sees the case.

*Bands, adhesions, etc.*, comprised by far the largest group in this series. There were 110 cases with 50 deaths, a mortality percentage of 45.45 per cent. There were 105 operations with 44 deaths, a mortality of 41.8 per cent.

This is comparatively the same as in Gibson's<sup>8</sup> series, where there were 186 cases and a mortality of 41 per cent., and Muzeneik<sup>9</sup> 104 cases with 48 per cent., also Miller<sup>10</sup> 58.8 per cent. in 68 cases. The treatment in this group varied. The lowest mortality was obtained in those cases in which it was found necessary only to relieve the obstruction. The more serious surgical procedures which involved opening of the gut, such as enterostomy and colostomy, were attended by an increasing death-rate. (See Chart II.)

The large number of cases in this group, 110, comprises 46.8 per cent. of the whole number reported. A striking fact in this group of cases was the frequency of previous abdominal operations which had occurred, and which antedated the obstruction from several days to twenty years. Of the 235 cases in this report, 105, or 44.68 per cent., gave a history of previous operation about the abdomen. Of these 105 cases 89 occurred in the band and adhesion group. Carrying the analysis further, it is found that 52 of the previous operations had been appendectomies for acute or chronic appendicitis, and 27 for some pelvic condition. Other previous operative procedures were in order of frequency as follows: gall-bladder, stomach, pancreas, previous obstruction, carcinoma of colon, adhesions, upper abdominal, hernia, ruptured gut, diverticulitis, lipoma of sigmoid and empyema.

The preponderance of obstruction cases following appendectomy and pelvic operations can be readily explained by the numerous adhesions found following operations for these conditions, especially for pelvic inflammatory disease, chronic appendicitis and drained acute appendicitis. Here is truly a great opportunity for prophylaxis against subsequent obstruction by more careful handling of intestines, the careful application of disinfectants to the appendix stump, and also particular attention to careful reperitonealization of raw surfaces in the abdomen.

*Intussusception*.—There were 36 cases in this group, 21 males and 15 females. Of these 5 were adults, 3 males and 2 females. The remainder, 31 in all, were children. There were 18 males and 13 females. The average age of the children was 5.17 months. The mortality in the intussusception group as a whole was 47.22, which also represents the operative mortality, as all cases were operated upon. Most of the cases were simply reduced (see chart) while 4 resections gave 100 per cent. mortality. The mortality as given for intussusception by Gibson<sup>8</sup> was 51 per cent. in 187 cases. The time

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factor is important in this group, as the best results were obtained in the cases operated upon early. Some of the earliest operations were done in this group, a very few hours following the onset of symptoms. The reason for this is obvious as the symptoms in children are typical and can scarcely be unrecognized. However, there are references, especially by older writers, showing that spontaneous cure may be brought about by sloughing off of the invaginated portion of the gut with subsequent passage of it by rectum. Haven<sup>11</sup> reported 59 intussusceptions out of a total of 258 cases of obstruction. Twelve of the 59 cases discharged the intussuscepted portion of the intestine by rectum, and of these 12 cases, 10 recovered.

*Volvulus of the colon*—Muzeneik<sup>9</sup> brings out some interesting data on this type of obstruction. In his statistical paper he shows that volvulus of the colon is much more common in the eastern European countries, especially Russia and the Balkans. There the incidence of volvulus in all cases of obstruction runs from 30 to 75 per cent. In Germany during the years 1918-1919 there was a tremendous and sudden increase in the number of cases as compared to former and later years. This, he thought, was due to post-war conditions. He attributes the increased frequency of volvulus of the colon in eastern Europe to the prevalence of dysentery, typhus and other diseases which cause a mesosigmoiditis with subsequent narrowing and contraction of the base of the mesentery. This gives a pedunculated offset to the sigmoid and makes possible torsion on its pedicle, especially if the loop of sigmoid becomes distended with gas and faeces. In the present series there were 16 cases with 7 deaths, a total mortality of 43.75 per cent. Thirteen cases were operated upon and 6 died for an operative mortality of 46.15 per cent. as compared to 58.5 per cent. of Miller,<sup>10</sup> Gibson<sup>8</sup> 54 per cent. and Muzeneik<sup>9</sup> 36 per cent. For operative details see Chart II. Of the 13 operations there were 2 resections with no deaths, 6 colostomies (including caecostomies and appendicostomies) with 4 deaths; in 5 cases, only the obstruction was relieved, with 2 deaths. Two cases were volvulus of the caecum, one complete with 360° torsion, the other a partial volvulus with 180° torsion. All others were of the sigmoid colon.

*Meckel's diverticulum*—There was nothing of note in this class of cases. The group was small, 7 in number, with 4 deaths, a mortality of 57.14 per cent. All cases were operated upon. Gibson<sup>8</sup> reported 42 cases with 62 per cent.

*Gall-stones*—Showed only 4 cases. All were operated upon and 3 died, with 75 per cent. mortality.

*Hernia*—There were 6 cases of external strangulated heria with 2 deaths, or 33.33 per cent. There was nothing unusual in these cases. One death was preceded by a resection of the small gut and the other by a primary enterostomy.

*Internal hernia* showed 4 cases, one case was herniated through an aperture in the mesentery, two were in internal sacs, and one in the lesser perito-

neal sac. One case died, a resection of the small intestine, 3 lived, with a mortality of 25 per cent.

*Carcinoma of the colon*—There were 16 cases all of which had suddenly closed down and become acutely obstructed. Sixteen cases were operated upon, with 5 resections and 3 deaths; 5 colostomies with 4 deaths, 4 enterostomies with 3 deaths, a total of 12 deaths, or 75 per cent.

The miscellaneous group deserves a few comments. There were 12 cases where the cause of obstruction was not ascertained at operation. In most of these the patient was too ill to permit of a prolonged search. Nine cases died; a mortality rate of 75 per cent. *Mesenteric thrombosis* showed 5 cases with 4 deaths. The only operative case that survived was one operated upon by Doctor Pool. This case is reported elsewhere. The other cases of the miscellaneous group are single ones and self-explanatory.

*Treatment*.—For the most part Chart II explains the result of treatment. The ante-operative and post-operative treatment, and the operative treatment with especial reference to enterostomy will be discussed briefly.

*Ante-operative treatment*.—The more important ante-operative procedures in acute intestinal obstruction may be stated as follows: (1) Rapid restoration of body fluids; (2) gastric lavage; and (3) enemata. Fluids may be restored most rapidly by means of hypodermoclysis and infusions of normal saline. This is probably the greatest single factor in combating the patient's shock and toxæmia, and it is a good rule to make, that these cases should not be operated upon until they have had at least 1000 cubic centimetres of saline by vein or subcutaneously.

Lavage is important to relieve the dilated stomach of toxic material from the intestine and also to prevent possible aspiration during anaesthesia.

Enemata which return gas and small particles of faecal matter may cause unnecessary delay in cases that are really obstructed. On the other hand a totally negative result from an enema is a consoling fact in assisting to make the proper diagnosis.

*Operative treatment*.—In general, the simplest procedure possible, in the presence of the pathological changes found, will obtain the greatest number of living patients. The necessity of more serious surgical measures and their results are best illustrated in Chart II.

The rôle of enterostomy in these cases has been much discussed. Van Beuren<sup>12</sup> believes that there is statistical evidence to indicate that enterostomy in acute ileus is of value if done early. However, late enterostomies, after paralysis of the intestine has taken place, drain only that loop into which the drainage tube is inserted. In this series there were 44 enterostomies done with 33 deaths, or 75 per cent. mortality as against 43.67 per cent. mortality for all other methods. This may be an unfair comparison because, in some cases, the patient was considered too ill to explore. On the other hand, it would seem to be bad practice to do only an enterostomy without exploration, as in 2 cases of the series where this was done the obstruction was found at autopsy to be due to a single band which could easily have

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been released. Supportive measures should be given as indicated during operation.

*Anæsthesia.*—General anæsthesia was used in 185 cases, with 86 deaths. Local anæsthesia was used in 29 cases with 21 deaths. Spinal was used only once with 1 death. In one case no anæsthesia was used.

*Post-operative treatment.*—The restoration of body fluids by saline clyses and infusions should be vigorously pursued. The patient's tongue is an excellent indicator; if it is dry and "beefy" in appearance, the patient still needs fluids. Fluids by mouth may be given after vomiting has ceased. Hypodermoclysis and other treatment should be concentrated at regular intervals, as every four hours, so that between treatment time the patient may rest. Lavage at regular intervals of every four hours should be rigidly carried out until the necessity for it is over. Position in bed is felt to be very important. The flat position in bed tends to distribute the intestines and their contents more evenly and prevents sagging of individual distended loops and the distended stomach toward the pelvis. This was pointed out by Gibson and Wade.<sup>18</sup> Washing out of the lower bowel at regular intervals will stimulate peristalsis and relieve the body of toxic material. The administration of charcoal gr. XV by mouth and its subsequent excretion by rectum gives positive proof that the obstruction to the gut has been overcome. Other less important measures practiced post-operatively in this series are too numerous to mention.

### SUMMARY

The conclusions from this study of acute intestinal obstruction are therefore given, with full knowledge of the pitfalls encountered in any statistical survey. The fact that all these cases are reported from one hospital and have been treated by the same group of individuals over a long period of time might increase the value of these conclusions. They are as follows:

(1) In this series there were 235 cases reported under the diagnosis of Acute Intestinal Obstruction; (2) the mortality was 51.48 per cent.; (3) the average age was thirty-two years; (4) there were 118 males and 117 females; (5) The average duration of symptoms before treatment was 3.9 days; (6) plain X-ray films are helpful in early diagnosis of acute obstruction to the intestines; (7) there were 218 operations, 17 not operated, and 49 secondary operations, with an operative mortality of 58.4 per cent.; (8) previous abdominal operations are a definite etiological factor for later obstruction, especially in the band group of cases; (9) the duration of obstruction before surgical correction is a very important factor in the prognosis; (10) the more severe surgical procedures, such as resections, gave a higher mortality than the cases where it was only necessary to release the obstruction by cutting a band; (11) primary enterostomy gives a higher mortality rate than a combination of all the other surgical procedures; (12) these statistics agree closely with statistics compiled thirty years ago and also with those of today.

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## ACUTE INTESTINAL OBSTRUCTION

A REPORT OF ONE HUNDRED AND EIGHTY-FIVE CASES TREATED IN THE  
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THE mortality rates of acute intestinal obstruction vary with respective series. Miller<sup>1</sup> reported a mortality of 29.4 per cent. of cases operated upon within twelve hours after the onset and 52.9 per cent. within twenty-four to forty-eight hours, and as the time increased the mortality increased; hence, after ninety-six hours, the rate was 84 per cent. Gibson's series of 1,000 cases had a mortality of 43.2 per cent. and 41.08 per cent. for the Van Beuren and Smith series of 1,089 cases. It is generally agreed that the rate averages about 40 to 50 per cent.—about one of every two patients die.

Since 1922, 185 cases of acute intestinal obstruction were admitted to the surgical services of Lebanon hospital, ten of which were non-operative cases. Of the total admissions 112 were males and seventy-three females, and of these, forty-two males and twenty-nine females died, making a total of 38.38 per cent. Excluding the group of intussusceptions the largest number of admissions were between the ages of fifty-one to sixty, with a total of thirty-six cases followed by twenty-seven in the seventh decade. The others occurred from one day to eighty-four years of age. From the third decade the foremost causative factor of acute intestinal obstruction was hernia. Sixty-six cases of this series were classified under the general heading of hernias, twenty-eight of which were due to indirect inguinal and twenty-one to femoral hernias. Four were umbilical, five ventral, three median and five congenital. Three cases were due to reduction "en masse."<sup>2</sup> Post-operative adhesions are second of importance with a total of twenty-six cases. Sixteen of these cases produced symptoms one month to twenty-five years after the primary operation and of these twelve were following appendectomies, four of which were drain cases. Ten cases were more acute in that the symptoms of acute intestinal obstruction appeared from three to six days after the primary operation for acute appendicitis. At the secondary operation the presence of fine adhesions between loops of bowel or connective tissue (bands) were found.

Obstruction as result of new growths was present in ten cases. Six of this group were due to adeno-carcinoma of the sigmoid and two of these had a secondary abscess (of the sigmoid) as result of perforation of the bowel. One new growth was found in the rectum, descending colon and hepatic flexure, respectively. It is of interest to state that none of these cases presented objective or subjective symptoms prior to the onset of symptoms of acute intestinal obstruction. There were seven cases of post-operative ileus

and nine patients who had a volvulus. One of these patients presented a volvulus of the ileum due to a band adherent to the left superior surface of the uterus. The others all had a volvulus of the sigmoid and one of these presented a tumor mass (adeno-carcinoma) of the sigmoid as well. Foreign bodies causing intestinal obstruction were present in three cases. In one, a female sixty-two years of age, a plum pit had produced a pin-point perforation of the ileum and localized abscess. The other two were due to a gall-stone in the ileum and a polyp. The polyp was present in a young male who was operated for a ruptured appendix. On the sixth day post-operative he began to present the clinical picture of intestinal obstruction, and on the eleventh day he passed a large slough through the anus, which was described by the pathologist as a polyp. Subsequent X-ray examination revealed the presence of papilloma of the caecal region. Ten cases were admitted with subjective symptoms of intestinal obstruction and a history of a previous operation. One of these had been operated upon previously for acute intestinal obstruction. All were kept under observation and after a reasonable period were discharged without any surgical interference. These cases are a group that have spontaneous relief or as result of enemata. In the first decade there is no group of cases that exceeded intussusception in the causation of acute intestinal obstruction. There were thirty-four cases, the majority of which were of the ileocaecal variety.<sup>3</sup>

During the above period cases of intestinal obstruction were admitted to the surgical services and operated upon for this condition without apparent cause, as adhesions, malignancy, *etc.* Ten of such cases were admitted and in three of the cases the cause was found—two had bands and one passed a polyp per rectum several days post-operative. The autopsies of four cases revealed the causes as (a) old tuberculosis band—with no other process in the body; (b) stone in the ileum; (c) benign stricture of the rectum, and (d) ileus secondary to a ruptured perinephritic abscess into the peritoneal cavity, which, in turn, was secondary to a stone in the ureter.

Disease of the vascular system in the region of the intestinal tract has not received its due recognition in the past. The fact that there are changes in the mesenteric vessels as there are throughout other parts of the body in arteriosclerotic conditions is becoming more generally recognized by the profession. Recently Green and Powers<sup>4</sup> have reported several cases of spontaneous haemorrhage into the omentum due to a rupture of branches of the left gastric, gastroduodenal, left epiploic and superior mesenteric arteries. The operations revealed definite arteriosclerotic changes in the vessel walls. The arteries are primarily involved in patients past the fourth decade and the condition is that of a general arteriosclerosis. As a rule, the involvement of arteries supplying the intestines, prior to the latter period, are usually due to (a) embolism secondary to a cardiac condition; (b) septic emboli, and (c) local thrombosis as result of pressure on the vessels. Involvement of the venous system will present the same clinical picture. Thrombosis of the

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venous vessels can result in involvement (*a*) from the bowel or (*b*) from a primary focus in another part of the body.

Two cases in this series illustrated the involvement of the venous vessels. Both were in young males sixteen and twenty years of age. One was admitted with a history of one day's duration with all the cardinal symptoms of intestinal obstruction and at operation twelve feet of ileum covered with a thin membrane and black in color with serosanguinous fluid were found. Post-mortem findings revealed about fifteen feet of small intestines up to the ileo-caecal valve gangrenous. The mesenteric vessels leading to this portion of intestines were thrombosed and markedly dilated. Dense adhesions between the old scar, mesentery and ileo-caecal region were present which caused the pressure on the mesenteric vessels and thrombosis. The second case was following an illness of two weeks' duration, subsequent to an upper respiratory infection which confined the patient in bed for ten days. The operative findings revealed the mesentery of the small bowel hard, infiltrated and covered with fibrin and fourteen feet of the bowel dark in color. Post-mortem examination found the gut to be gangrenous, the mesenteric glands were large, and one section contained purulent material. The veins were thrombosed, with small abscesses in the liver. These are illustrations of thrombosis of the venous vessels of the mesentery. The first is due to local involvement and second from a primary focus in another part of the body (upper respiratory tract).

TABLE I

Cases	No.	Male	Female	Deaths		% of total admissions	% of total mortality
				M.	F.		
Hernias	66	44	22	10	7	37.5	23.94
Adhesions	26	15	11	5	4	14.77	12.67
Malignancy	10	7	3	2	2	5.4	5.6
Secondary ileus	7	4	3	4	3	3.97	9.85
Volvulus	9	4	5	2	2	5.1	5.3
Mesenteric thrombosis	7	3	4	3	4	3.78	9.85
Anomalies	3	2	1	1	1	1.62	2.81
Intussusception	34	23	11	7	4	18.27	15.48
Foreign bodies	3	1	2	1	1	1.62	2.81
Miscellaneous	10	7	3	6	1	5.38	9.8
Non-operative	10	2	8	0	0	5.4	0.0

In summation, one readily appreciates that hernias, adhesions, and intussusceptions are the greater factors numerically but not so far as the mortality rate is concerned. In mesenteric thrombosis, post-operative ileus, anomalies, malignancy and cases of unknown origin, the mortality either equals or surpasses the percentage of admissions of each respective group.

*Pathological Discussion.*—Extensive investigation has developed various opinions about the toxicity in acute intestinal obstruction. As the result, a number of theories have been formulated and classified as (1) bacterial; (2) intoxication; (3) dehydration—of body fluids and salts; (4) infections; (5) neurological; (6) secretory—excessive or perverted; and (7) circula-

tory. Many of the above have supportive evidence experimentally, while others are still debatable. However, with the reviews of operative and extensive pathological findings, and the knowledge of the sequence of events of this condition (pathological physiology) one is immediately impressed with the important changes taking place within the circulation of the intestinal tract. The interference with the return flow, thrombosis, infarction, edema, exudation of a serous or hemorrhagic fluid, are a series of definite progressive pathological circulatory changes, which result finally in non-viable or gangrenous gut. There can be no question that the prognosis should be guarded and depend upon the progressive changes and the success of any surgical or therapeutic measure is based, primarily, on the circulatory changes. The duodenum, jejunum and colon vary as far as intramural blood supply is concerned and react to intra-intestinal pressure differently. The pressure within the duodenum can interfere with the venous flow if it reaches thirty-five to forty-five millimetres of mercury or above, while the jejunum and ileum fifty-five to sixty-five and ninety-five for the colon, will be sufficient to produce interference to the venous flow.<sup>5</sup>

The work of Raine and Perry<sup>6</sup> as well as the work of Hartwell and Hoguet<sup>7</sup>—though they state that the salt solution is the important factor, nevertheless, the success of their experiment depends upon the circulation being normal—with summary of the above (paragraph) is sufficient to demand the respect and consideration of the profession. It can be emphatically stated that the toxicity of intestinal obstruction is due to the vascular disturbances and the subsequent changes thereof. The other factors (especially the sodium chloride), as enumerated, are of importance, but only in a secondary measure, and the therapeutic measures based upon these experimental observations depend upon the circulation for their successful action.

The effort to understand the mechanics and chemistry of acute ileus has stimulated extensive investigation and the theories: (1), of stimulation of the splanchnics—resulting in dilatation—through the inhibitory action of the nerves as well as (2), the action of sodium chloride, are the foremost conclusions advanced. The cases of ileus, with definite local and general peritonitis, are caused by the action of the toxins, causing a disturbed innervation of the intestinal wall and partly to the formation of masses of flakes of fibrin with the cohesion of coil to coil, thus interfering with the circulation.<sup>8</sup> However, the cases where no visible infection or presence of pus can be seen are the ones that now present themselves for consideration. These cases usually develop symptoms of intestinal obstruction from three to six days after the operation. The questions now present themselves, (a) are cases of this type the result of neurological disturbances as suggested? (b) is it due to a disturbance of the sodium chloride in the body? (c) is it due to a combination of the above? or (d) is it due to some other factors? In order to answer the questions we will consider the following:

(a) The action of smooth muscle is not totally dependent upon its extrinsic nerve supply, thus differing from the voluntary or striated muscle—"thus,

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whereas the voluntary muscle is intimately dependent on its connections with the central nervous system, and in the absence of this is reduced to a flabby inert tissue, the smooth muscle, isolated from its nervous connections, presents in many cases rhythmic contractions and can carry out a peripheral adaption to its environment. These rhythmic contractions are almost invariably observed if the muscular tissue be subjected to a certain amount of tension after separation from the central nervous system.<sup>9</sup>

(b) The phenomenon of fatigue depends upon two factors—(a) consumption of contractile material or substances available for the supply of potential energy. (b) A more important factor is the accumulation of waste products of contraction. Among these products lactic acid is probably of great importance.<sup>10</sup>

(c) "Intestinal muscle acts independent of the spinal nerve supply. The rhythmical contractions of the intestines are muscular in origin (myogenic) while the more coördinated peristaltic movements depend upon the intrinsic nervous mechanism (Auerback Plexus). The intestines, however, are not dependent for either movement upon their connections with the central nervous system. Like the stomach, it is an automatic organ whose activity is simply regulated through its extrinsic nerves."<sup>11</sup>

(d) Disturbances of the autonomic system present clinical entities but none of serious concern nor symptoms pointing to any intestinal obstruction. These entities are vagotonia and sympathotonia.<sup>12</sup>

(e) When nerves to the digestive tract are cut, little happens. There is a short interval during which the muscle may be somewhat atonic and during which peristalsis is shallow, but later, in many experimental animals, little difference from the normal can be made out.<sup>13</sup>

(f) The cutting of the sympathetics in man has seldom resulted in any disturbance.<sup>14</sup>

The neurological theory has been advanced by the work of many investigators, especially the experimental work of Cannon and Murphy,<sup>15</sup> who showed that a dynamic ileus experimentally produced by crushing the testicle could be presented by cutting the splanchnics. The recent work of spinal anaesthesia with clinical observations has been suggested as supportive evidence of this theory.

Physiologically, the stimulation of the splanchnics in experimental animals gives rise to a dilatation of the intestines. The reverse is true with the vagus autonomic system. These reactions are purely of a tonic nature. The question arises, can excessive stimulation of the above produce acute ileus with the typical picture of acute intestinal obstruction and death? This has not been demonstrated, for if one stimulates the nerve to a striated muscle one gets a definite twitch which can be produced time and again in practically the same form, but if one stimulates the vagi or sympathetics one gets varying changes of weak inhibition and stimulation which cannot be duplicated with any degree of certainty or precision.<sup>16</sup> It has also been demonstrated that one can get purely inhibitory effects by stimulating the vagus, just as one

can get purely augmentary effects by stimulating the splanchnics.<sup>17</sup> Hence, it is obvious that the reaction to stimulation of the splanchnics is not constant nor definite. However, some have advanced the clinical entities of vagotonia and sympathotonia as manifestations of disturbance of the respective autonomic systems, but none has ever reported a case under the latter condition, with a clinical picture of acute intestinal obstruction and death. In fact, the possibility of a spontaneous case of acute ileus without any injury or subsequent to a recent operation is remote, speculative, and never reported.

The injury to the testicle (Cannon and Murphy Exp.) produces a stimulus which is transferred to the higher centres through the splanchnics. The result is shock. Crile believes the reason for shock is due to exhaustion of the vasomotor centre with splanchnic vascularization. However, primary shock, which appears to be the immediate reflex effect of a sudden injury due to inhibition of the heart through the vagus, results in dilatation of the splanchnic area. With this comes an increased permeability of the arteriol walls so that fluid passes out into the tissues. This gives rise to oedema and interference with the nutrition to the intestines through impaired circulation (stasis) resulting in ileus.<sup>18</sup> By cutting the splanchnic fibres the stimulus is not transferred to the higher centres and therefore no response as described. The interpretation of this experiment differs from the authors in that they described the result due to stimulation of the splanchnic nerves whose action is supposed to be directly upon the intestinal muscle, while the deduction above is that the stimulus is transmitted through the splanchnics to the higher centres. In fact, clinically, the same mechanism is present in patients who have had severe injuries in other parts of the body, other than the abdomen as upper extremities, chest, head, *etc.* Many of these cases of injury to the testicle and abdomen recover without any permanent condition of acute dilatation. A frequent example is the prize fighter who is struck in the abdomen and recovers after a short time. The reason for this is due to the stability of the vasomotor mechanism reestablishing the circulation by control of the arteriols in the splanchnic area.

The use of spinal anaesthesia in the treatment of acute ileus has been reported by some as satisfactory, but others were unable to report favorable results. The reason for this is explained as follows: (a) at operation, where spinal anaesthesia has been used, there is a collapsed bowel. This is the result of paralysis of the splanchnics with loss of vasomotor control as well as the tonic influence of the sympathetics. The result is identical with shock, and, in fact, the result of the spinal anaesthesia is the formation of clinical shock. One readily appreciates the patient's appearance, his color, clammy perspiration, difficulty in breathing, rapid, weak pulse, and the extremely low blood-pressure (a decrease from 50 to 100 millimetres of mercury). This is one of the reasons for keeping the patient in a Trendelenburg position to overcome the vascular anaemia to the higher centres as a result of the vasomotor instability, resulting in splanchnic vascularization. (b) In cases of ileus the condition has been present for a number of days, during which time

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there is interference with the circulation (nutrition) and increased distention. The lactic acid present paralyzes the neuromuscular plate, thus severing its control, which is purely a tonic factor. The excessive intra-intestinal pressure (distention) impairs the venous flow, and indirectly the arteriols, resulting in dilatation, due to back pressure from the venous obstruction. Therefore, the rapid vasodilatation, after the use of the spinal anaesthesia, does not develop. For the arteriols are dilated and the sudden change in the splanchnic area, as described in conditions of shock, does not take place. The distention also continues—for this pressure has distended the muscular wall, producing exhaustion and loss of muscular elasticity. Therefore, under the latter conditions, the use of spinal anaesthesia is of no value, and its influence can be of importance only as a therapeutic measure when the condition of ileus is treated early. Here the mechanisms are still under the normal influences.

Acute ileus results from the action of toxic substances as in pneumonia, uræmia and drug conditions. The action here is directly upon the muscular layers of the bowel, producing a toxic paresis.<sup>19</sup> In surgical conditions the appearance of acute ileus takes place from the third to sixth day after the primary operation, with the insidious onset of nausea, vomiting, retching, distention and cramps. The pulse, respiratory rates as well as the temperature are increased. The blood shows a leucocytosis. The onset from the third day suggests the possibility of some form of inflammation as in post-partum conditions—sepsis.

The agents that can produce inflammatory reactions other than bacterial invasion are chemical, traumatic, physical and thermal agents. The presence of a dynamic ileus after the primary operation (excluding the inflammatory group) within a limited period suggests the possibility of the onset having taken place at the first operation and after a period of development the entity appears. The prolonged exposure of gut, excessive handling of the bowel, pressure on the intestines through abdominal pads and instruments (retractors) are agents competent to produce injury to the bowel. It is this injury (maltreatment) that is responsible for the development of subsequent ileus, for it has been definitely demonstrated that obstruction, without injury to the intestines, will not produce ileus. However, ileus can be produced by injury to the intestines (maltreatment) without any obstruction anywhere in the bowel.<sup>20</sup> In fact, it has been shown that injury to the intestinal muscles will give the same symptoms as the reflex upsets that result through the splanchnic.<sup>21</sup>

The appearance of the bowel, pathologically, reveals two distinct types: (a) thin, injected, covered with fibrin or flakes of pus, which are found in cases of post-operative peritonitis; and the (b) pale, white, anaemic, distended under excessive pressure. The color of the second type (pale-anaemic) is most likely due to the excessive intra-intestinal pressure forcing the blood out of the vessels, thus giving this characteristic appearance.

In summarizing it can be stated that (a) the physiological characteristic

features of the smooth muscle (intestinal) isolated from its nervous connections can carry out a peripheral adaptation to its environment, which is readily brought about through paralysis of the neuromuscular plate by retention of lactic acid. (b) The ability to maintain its function independent of the nervous system (myogenic theory) is a definite physiological fact as well as (c) the clinical knowledge that cutting of the sympathetics has no effect upon the digestive function in man. (d) The development of ileus after a constant period pointing to the origin at the primary operation with the enumerated agents giving rise to a non-suppurative inflammatory reaction, and the (e) inability of spinal anaesthesia to influence the condition on all occasions are supportive factors in stating conclusively that the cause of acute ileus after a primary operation (excluding the peritonitis cases) is due primarily to an injury to the intestines at the operation which gives rise to a non-suppurative inflammation. The effect of the splanchnic system upon this condition is not of serious significance.

The work of the sodium chloride advocates has been conclusive and of importance, but as Hartwell and Hoguet have stated, the success of their experiment depends upon the circulation being maintained as normal, while they supply the salts and fluid to the body. It is also a fact that the first of the series of events is not vomiting with depletion of body fluid and salts but the interference with the circulation.

*Diagnosis and treatment.*—These phases have been described and discussed. The literature and reports are explicit and cover this phase to a large degree. However, a number of suggestions have been advanced to assist in the diagnosis but none other than two are of great importance: (a) Radiographic examination; (b) gastric lavage. Radiographical investigation by the use of barium enemas has conclusively proven its worth and the work of Schwarz advocating the use of the röntgenography of the abdomen has proven to be of material assistance. The importance of visualization of gas in the small intestines on radiographical examination in adults has not received its due consideration. For the presence of the latter is synonymous with intestinal obstruction.<sup>22</sup>

One of the most useful diagnostic aids that can be used with simplicity and ease, especially where there are no first-hand facilities as X-ray, *etc.*, is gastric lavage. The washing of the stomach until the return flow is clear, and repeated within an hour, is of great significance, especially if the return fluid of the last washing contains high intestinal or fecal-like material. The presence of the latter is synonymous and pathognomonic of intestinal obstruction.

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## ACUTE INTUSSUSCEPTION

WITH SPECIAL REFERENCE TO TREATMENT BY RESECTION OF THE BOWEL\*

OBSERVATIONS ON THIRTY-FOUR CASES ADMITTED TO THE  
CHILDREN'S HOSPITAL IN PHILADELPHIA

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THE purpose of this paper is: First, to review the cases of intussusception admitted to the Children's Hospital of Philadelphia in the last seven years, and to compare this series with the series of the ten previous years reported by Brown; second, to report a successful application of Brown's method of reduction, by incision, of the constricting ring of the intussusception; and, third, to report a successful resection of the distal end of the ileum, the cæcum, the ascending, transverse and descending colon to the sigmoid, all of which were involved in the intussusception.

TABLE I  
*Doctor Brown's Series*

Duration of intussusception	No. of cases	Reduced	Not reduced		Per cent. mortality according to duration of intussusception
24 hours or less.....	9	6	3	0	33.3
48 hours.....	9	2	5	1	66.6
72 hours.....	6	1	3	0	83.3
4 days.....	2	0	2	0	100.0
5 days.....	3	0	0	0	100.0
6 days.....	1	0	0	0	100.0
Over 6 days.....	1	1	0	0	0.0
Total for series.....	31	10	13	1	64.5 per cent. mortality

In 1924, Doctor Brown read a paper before this Academy in which he reported thirty-one cases (Table I) admitted to the Children's Hospital of Philadelphia with intussusception, between 1915 and 1924.<sup>1</sup> We wish to report an additional thirty-four cases (Table II) which have been admitted to the Children's Hospital since that time, making a total of sixty-five cases. (Table III.) On the accompanying charts are tabulated the results, but there are a few points to which we wish to call attention.

The percentage of mortality has been reduced from 64.5 per cent., in Brown's report to 35.3 per cent. in this later series, the best results, as would

\* Read before the Philadelphia Academy of Surgery, January 4, 1932.

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TABLE II

Duration of intussusception	No. of cases	Reduced	Not reduced	Per cent. mortality according to duration of intussusception	
		Lived	Died	Lived	Died
24 hours or less.....	13	9	4	0	0
48 hours.....	10	8	1	1	0
72 hours.....	3	1	0	0	2
4 days.....	2	1	1	0	0
5 days.....	3	0	3	0	0
7 days.....	1	1	0	0	0
Over 7 days.....	1	0	0	1	0
Duration unknown.....	1	0	1	0	0
Total for series.....	34	20	10	2	2
				35.3 per cent. mortality	

be expected, being in the cases operated on early. Thirteen patients were operated on in the first twenty-four hours, with four deaths, or 30.8 per cent. mortality; ten were operated on in the first forty-eight hours, with one death,

TABLE III  
(Combined I and II)

Duration of intussusception	No. of cases	Reduced	Not reduced	Per cent. mortality according to duration of intussusception	
		Lived	Died	Lived	Died
24 hours or less.....	22	15	7	0	0
48 hours.....	19	10	6	2	1
72 hours.....	9	2	3	0	4
4 days.....	4	1	3	0	0
5 days.....	6	0	3	0	3
6 days.....	1	0	0	0	1
7 days.....	2	2	0	0	0
Over 7 days.....	1	0	0	1	0
Duration unknown.....	1	0	1	0	0
Total both series.....	65	30	23	3	9
				49.2 per cent. mortality	

or 10 per cent. mortality. After this time the mortality rapidly increased. In several of the cases appendectomy was done, but we do not recommend this procedure unless the appendix is gangrenous.

TABLE IV

CASE I.—(Hospital Case No. 501), F. L., male, four years old, palpable mass. Feeding—? Condition on admission—fair. Type—colic. Operation to reduce. Result—died. Remarks.—Reduced with difficulty. Colon stitched to abdominal wall. Recurred. This case reported.

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CASE II.—(Hospital Case No. 227), F. B. B., female, six years old; palpable mass. Feeding—? Condition on admission—fair. Type ileo-cæcal. Duration—thirty hours. Operation to reduce. Result—died. Remarks.—Acute appendicitis. Ileum explored for questionable tumor and sutured. Wound reopened for infection.

CASE III.—(Hospital Case No. 263), T. E., female, four and one-half years old; palpable mass. Feeding—? Condition on admission—good. Type—ileo-cæcal. Duration—one week. Operation to reduce. Result—recovered. Remarks.—Appendix removed.

CASE IV.—(Hospital Case No. 1062), R. C., female, eight months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—seventeen hours. Operation to reduce. Result—recovered.

CASE V.—(Hospital Case No. 1088), M. T., female, ten and one-half months old; palpable mass. Feeding—breast. Condition on admission—fair. Type ileo-cæcal. Duration—thirty-six hours. Operation to reduce. Result—recovered.

CASE VI.—(Hospital Case No. 122), V. M., female, ten months old; non-palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal. Duration—forty hours. Operation to reduce. Result—recovered. Remarks.—Appendectomy.

CASE VII.—(Hospital Case No. 391), A. M. A., female, two months old; non-palpable mass. Feeding—breast and bottle. Condition on admission—poor. Type—ileo-cæcal. Duration—three days. Irreducible operation. Result—died. Remarks.—Resected part of mass. Cæcostomy. Died on table.

CASE VIII.—(Hospital Case No. 355), V. T., female, three months old; palpable mass. Feeding—breast. Condition on admission—poor. Type—ileo-cæcal and colic. Duration—five days. Operation to reduce. Result—died. Remarks.—Peritonitis. Reduced with difficulty.

CASE IX.—(Hospital Case No. 370), D. L. G., female, four months old; non-palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal. Duration—fourteen hours. Operation to reduce. Result—died. Remarks.—Appendectomy. Bronchial pneumonia.

CASE X.—(Hospital Case No. 608), F. C., male, five months old; palpable mass. Feeding—breast. Condition on admission—poor. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—died. Remarks.—Bowel torn in two places. Sutured.

CASE XI.—(Hospital Case No. 652), C. G., male, four and one-half years old; non-palpable mass. Feeding—? Condition on admission—fair. Type—ileo-cæcal. Duration—eleven days. Irreducible operation. Result—recovered. Remarks.—two and one-half inches ileum resected. Symptoms followed gulping spaghetti.

CASE XII.—(Hospital Case No. 781), M. P., male, seven months old; palpable mass. Feeding—breast and bottle. Condition on admission—fair. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—died. Remarks.—Eviscerated fifteen days after operation.

CASE XIII.—(Hospital Case No. 791), W. H., male, seven weeks old, palpable mass. Feeding—breast. Condition on admission—poor. Type—ileo-cæcal and colic. Duration—thirty-six hours. Irreducible operation. Resected. Result—recovered. Remarks.—Case reported.

CASE XIV.—(Hospital Case No. 415), M. L., male, eleven months old; palpable mass. Feeding—? Condition on admission—fair. Type—ileo-cæcal. Duration—three days. Operation to reduce. Result—recovered. Remarks.—Stitched to abdomen.

CASE XV.—(Hospital Case No. 630), J. W., female, nine months old; palpable mass. Feeding—breast. Condition on admission—poor. Type—ileo-cæcal. Duration—five days. Operation to reduce. Result—died twenty-six hours after operation.

CASE XVI.—(Hospital Case No. 691), M. G., male, eight months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—

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forty-one hours. Operation to reduce. Result—recovered. Remarks.—Time of operation twenty-one minutes.

CASE XVII.—(Hospital Case No. 378), E. M., male, three months old; palpable mass. Feeding—? Condition on admission—good. Type—ileo-cæcal. Duration—twenty hours. Operation to reduce. Result—recovered. Remarks.—Appendectomy.

CASE XVIII.—(Hospital Case No. 979), T. B., male, eleven months old; palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal. Duration—thirty-six hours. Operation to reduce. Result—recovered. Remarks.—Appendectomy.

CASE XIX.—(Hospital Case No. 264), D. G., male, eight months old, palpable mass. Feeding—breast. Condition on admission—fair. Type ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—died. Remarks.—Cæcum sutured to abdominal wall.

CASE XX.—(Hospital Case No. 126), R. A., female, five and one-half months old; palpable mass. Feeding—breast. Condition on admission—good. Type—colic. Duration—twelve hours. Operation to reduce. Result—recovered. Remarks.—Ileum sutured to cæcum and abdominal wall.

CASE XXI.—(Hospital Case No. 137), A. P., male, six and one-half months old; palpable mass. Feeding—? Condition on admission—good. Type—ileo-cæcal. Duration—two hours. Operation to reduce. Result—recovered. Remarks.—Local anaesthesia.

CASE XXII.—(Hospital Case No. 785), F. D., male, eleven and one-half months old; non-palpable mass. Feeding—breast. Condition on admission—? Type—ileo-cæcal. Duration—5 days. Operation to reduce. Result—died. Remarks.—Ileum perforated before operation. Ileostomy.

CASE XXIII.—(Hospital Case No. 945), J. F., male, seven months old; palpable mass. Feeding—? Condition on admission—fair. Type—ileo-cæcal. Duration—thirty-seven hours. Operation to reduce. Result—recovered. Remarks.—History of attack two months ago. Adhesions found. Sutured to abdominal wall.

CASE XXIV.—(Hospital Case No. 1251), S. G., female, eight months old; palpable mass. Feeding—? Condition on admission—fair. Type—ileo-cæcal. Duration—thirty-six hours. Operation to reduce. Result—recovered. Remarks. Cæcum stitched to the abdominal wall.

CASE XXV.—(Hospital Case No. 1250), G. M. F., male, six months old; palpable mass. Feeding—breast. Condition on admission—poor. Type—ileo-cæcal. Duration—four days. Operation to reduce. Result—died. Remarks.—Cæcum stitched to abdominal wall.

CASE XXVI.—(Hospital Case No. 194), P. G., female, six years old; palpable mass. Feeding—? Condition on admission—fair. Type—colic. Duration twenty-four hours. Operation to reduce. Result—recovered. Remarks.—Patient fell twenty-four hours before admission. Mesentery sutured.

CASE XXVII.—(Hospital Case No. 192), G. R., male, seven months old; palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal and colic. Duration—eighteen hours. Operation to reduce. Result—recovered. Remarks.—Cæcum stitched to abdominal wall.

CASE XXVIII.—(Hospital Case No. 1586), F. B., female, six months old; palpable mass. Feeding—breast and bottle. Condition on admission—good. Type—ileo-cæcal and colic. Duration—twenty-four hours. Operation to reduce. Result—recovered. Remarks.—Cæcum stitched to abdominal wall.

CASE XXIX.—(Hospital Case No. 808), M. D. F., male, five months old; palpable mass. Feeding—breast. Condition on admission—good. Type—double. Duration—two days. Operation to reduce. Result—recovered. Remarks.—Reduced by Brown's method.

CASE XXX.—(Hospital Case No. 1363), A. P., male, five months old; palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal and colic. Duration—four days. Operation to reduce. Result—recovered. Remarks.—Cæcum stitched to abdominal wall.

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CASE XXXI.—(Hospital Case No. 2356), M. Z., male, four and one-half months old; palpable mass. Feeding—breast and bottle. Condition on admission—fair. Type ileo-cæcal. Duration—twelve hours. Operation to reduce. Result—recovered.

CASE XXXII.—(Hospital Case No. 3170), G. P., male, seven months old; palpable (?) mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—eighteen hours. Operation to reduce. Result—recovered. Remarks.—Ten inches of bowel involved.

CASE XXXIII.—(Hospital Case No. 2936), R. B., male, twenty-one months old; palpable (?) mass. Feeding—breast and bottle. Condition on admission—fair. Type—ileo-cæcal. Duration—two days. Operation to reduce. Result—recovered. Remarks.—Appendectomy.

CASE XXXIV.—(Hospital Case No. 3159), E. S., female, three and one-half months old; palpable mass. Feeding—breast. Condition on admission—poor. Type—ileo-cæcal and colic. Duration—sixty-three hours. Irreducible operation. Result—died. Remarks.—Extensive resection of gangrenous bowel. Patient died a few hours later.

The cæcum was sutured to the anterior abdominal wall in several cases, but these did no better than the others. Only one case recurred and this was due to an adenoma of the descending colon, in a boy four years old. His condition did not warrant a resection at the first operation, so the colon was sutured to the anterior abdominal wall after the reduction of the intussusception. The intussusception recurred five weeks later and a Witzel enterostomy was done, as the patient's condition again did not warrant a resection. Four days after the second operation the patient pulled out the catheter, which was reinserted, but the patient died from peritonitis.

TABLE V  
*Doctor Brown's Series*

CASE I.—(Hospital Case No. 562), G. F., male, one year old; palpable mass. Feeding—breast and bottle. Condition on admission—good. Type—ileo-cæcal. Duration—forty-eight hours. Operation to reduce; suture of ileum. Result—recovered. Remarks.—Ileum sutured to abdominal wall.

CASE II.—(Hospital Case No. 696). L. D., female, four and one-half months old; palpable (?) mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal. Duration—forty-eight hours. Irreducible operation. Result—died. Remarks.—Ileum anastomosed to colon. Intussusception left outside abdomen. Died nine hours later.

CASE III.—(Hospital Case No. 37), J. L., male, seven months old; palpable mass. Feeding—breast, three months. Condition on admission—quite toxic. Type—ileo-cæcal. Duration—thirty-six hours. Irreducible operation. Result—recovered. Remarks.—Resection. Murphy button anastomosis. Eviscerated seventh day post-operative.

CASE IV.—(Hospital Case No. 414), M. B., male, four months old; palpable mass. Feeding—breast. Condition on admission—very toxic. Type—ileo-cæcal. Duration—three days. Irreducible operation. Result—died. Remarks.—Mass brought outside abdomen and drained. Died in one hour. Operation, twenty-five minutes.

CASE V.—(Hospital Case No. 440), P. D., male, seven months old; palpable mass. Feeding—breast. Condition on admission—toxic. Type—ileo-cæcal. Duration—four days. Operation to reduce. Result—died. Remarks.—Temperature, 107°; pulse, 136; respirations, 60 at death five and one-half hours after operation.

CASE VI.—(Hospital Case No. 75), M. S., female, eleven months old; non-palpable mass. Feeding—breast. Condition on admission—very toxic. Type—ileo-cæcal. Duration—four days. Operation to reduce. Result—died. Remarks.—Temperature, 105°; pulse, 158; respirations, 60 at death ten hours after operation. Bowel good.

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CASE VII.—(Hospital Case No. 361), B. B., male, one year old; palpable mass. Feeding—breast, nine months. Condition on admission—toxic. Type—ileo-cæcal. Duration—five days. Irreducible operation. Result—died. Remarks.—Ileo-colostomy. Lived seven hours.

CASE VIII.—(Hospital Case No. 222), F. G., male, four months old; palpable mass. Feeding—breast. Condition on admission—very toxic. Type—ileo-cæcal. Duration—three days. Irreducible operation. Result—died. Remarks.—Resection. Anastomosis.

CASE IX.—(Hospital Case No. 26), H. B., female, eight and one-half months old; palpable mass. Feeding—?. Condition on admission—good. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—recovered. Remarks.—Appendectomy. Cæcum sutured to abdominal wall.

CASE X.—(Hospital Case No. 300), W. B., male, nine months old; palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal. Duration—three days. Operation to reduce. Result—died. Remarks.—Diarrhoea and bloody stools for one month. Died six hours after operation. Temperature, 105°; pulse, 148; respirations, 54.

CASE XI.—(Hospital Case No. 423), M. R., female, ten months old; non-palpable mass. Feeding—breast, six months; bottle, four months. Condition on admission—good. Type—mid-ileum. Duration—twenty-five days (?). Operation to reduce. Result—died. Remarks.—Intussusception easily reduced. Poor reaction. Died in twelve hours post-operative.

CASE XII.—(Hospital Case No. 647), E. M., female, five months old; palpable mass. Feeding—?. Condition on admission—good. Type—ileo-cæcal. Duration—three days. Operation to reduce. Result—died. Remarks.—Temperature, 106°; pulse, 148; respirations, 36; at death in seventy-two hours.

CASE XIII.—(Hospital Case No. 378), J. C., male, three months old; non-palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—forty-eight hours. Operation to reduce. Result—died. Remarks.—Temperature, 107°; pulse, 140; respirations, 60; at death five hours post-operatively. Poor reactions.

CASE XIV.—(Hospital Case No. 259), R. N., male, four months old; non-palpable mass. Feeding—breast. Condition on admission—fair. Type—ileo-cæcal. Duration—six days. Irreducible operation. Result—died. Remarks.—Resection, anastomosis. Died in shock.

CASE XV.—(Hospital Case No. 189), D. R., male, one year old; non-palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—recovered. Remarks.—Developed diphtheria.

CASE XVI.—(Hospital Case No. 180), A. K., female, ten months old; palpable mass. Feeding—breast, six months; bottle, four months. Condition on admission—fair. Type—ileo-cæcal. Duration—five days. Irreducible operation. Result—died. Remarks.—Ileostomy. Died from shock. Time of operation, twenty minutes.

CASE XVII.—(Hospital Case No. 328), M. T., male, six months old; palpable mass. Feeding—?. Condition on admission—good. Type—ileo-cæcal. Duration—forty-eight hours. Operation to reduce. Result—died. Remarks.—Faecal vomiting next day. Died forty-eight hours post-operatively. Cæcum sutured to anterior abdominal wall. Operation, twenty-five minutes.

CASE XVIII.—(Hospital Case No. 281), D. P., male, eight months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—five days. Irreducible operation. Result—died. Remarks.—Resection. Murphy button anastomosis. Ileostomy above anastomosis. Died in one hour.

CASE XIX.—(Hospital Case No. 217), S. C., male, ten months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—died. Remarks.—Papilloma resected from terminal ileum. Lived sixty hours. Operation, twenty minutes.

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CASE XX.—(Hospital Case No. 734), L. D., female, four months old; palpable mass. Feeding—?. Condition on admission—poor. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—died. Remarks.—Died one hour after operation. Temperature, 103°; pulse, 136; respirations, 48.

CASE XXI.—(Hospital Case No. 760), G. C., male, six months old; palpable mass. Feeding—?. Condition on admission—poor. Type—ileo-cæcal. Duration—forty-eight hours. Reduction not attempted. Result—died. Remarks.—Constipation, vomiting, bloody stool and convulsions. Died as operation was started.

CASE XXII.—(Hospital Case No. 797), A. B., female, five months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—twelve hours. Operation to reduce. Result—lived. Remarks.—Anchor suture to anterior abdominal wall.

CASE XXIII.—(Hospital Case No. 430), H. H., male, six months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—three days. Operation to reduce. Result—died. Remarks.—Mass palpable in rectum. Easily reduced. Operation eighteen minutes.

CASE XXIV.—(Hospital Case No. 309), J. D., male, eight months old; palpable mass. Feeding—? Condition on admission—fair. Type—ileo-cæcal. Duration—eight hours. Operation to reduce. Result—lived. Remarks.—Anchor suture to anterior abdominal wall. Time of operation, ten minutes.

CASE XXV.—(Hospital Case No. 777), A. A., male, six months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—lived. Remarks.—Appendectomy. Anchor suture.

CASE XXVI.—(Hospital Case No. 800), R. C., male, four months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—twenty-four hours. Operation to reduce. Result—died. Remarks.—Mass extended to rectum. Difficult to reduce. Appendectomy. Anchor suture. Left table in good condition. At death temperature, 105°; pulse, 166; respirations, 68.

CASE XXVII.—(Hospital Case No. 9), A. I., female, six years old; palpable mass. Condition on admission—good. Type—mid-ileum. Duration—twenty-four hours. Operation to reduce. Result—recovered. Remarks.—Dark red cauliflower tumor, the intussusception, in mid-ileum, reduced. No biopsy. Tumor was haemangiosarcoma.

CASE XXVIII.—(Hospital Case No. 243), M. V., female, eight months old; palpable mass. Feeding—bottle. Condition on admission—good. Type—ileo-cæcal. Duration—thirty-six hours. Operation to reduce. Result—lived. Remarks.—Anchor suture.

CASE XXIX.—(Hospital Case No. 351), R. S., male, nine months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—three days. Operation to reduce. Result—lived. Remarks.—Intussusception to splenic flexure. Easily reduced, and anchor suture to abdominal wall.

CASE XXX.—(Hospital Case No. 469), R. C., female, seven months old; palpable mass. Feeding—breast. Condition on admission—good. Type—ileo-cæcal. Duration—thirty-two hours. Irreducible operation. Result—died. Remarks.—Constriction incised as described in text.

CASE XXXI.—(Hospital Case No. 549), S. T., male, six years old; palpable mass. Condition on admission—good. Type—ileo-cæcal. Duration—fifteen days. Operation to reduce. Result—lived. Remarks.—Congenital deformity of bowel.

CASE XXXII.—(Hospital Case No. 525), R. C., male, six months old; palpable mass. Feeding—breast. Condition on admission—good. Type—? Duration—five weeks. Operation—? Result—lived. Remarks.—Mass felt 3 centimetres within rectum. Operative permission refused. Colic, bloody stools, loss of weight for five weeks. Improved. Left hospital against advice.

One patient progressed well, and had the stitches removed on the fifteenth day after operation. Some hours later the abdominal wound separated and the

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intestines were eviscerated. To replace the intestines a general anæsthetic had to be given, and the patient died of shock following this procedure. This is not an uncommon complication following these operations in children, and it should be anticipated by using meticulous care in the closure of the wound in the abdominal wall.

Since the above accident, we have used mattress stay sutures fastened over small rubber tubes (Quill suture) to prevent cutting of the skin. The stitches are left in for ten or twelve days and when they are removed the wound is strapped with sterile adhesive on the skin. This is the routine method used by Lee in closing the abdominal wounds in infants. In one case there was a history of a similar previous attack two months before, and at operation adhesions were found between the ileum and the cæcum. In this case the cæcum was stitched to the abdominal wall after reduction. One case was operated on two hours after onset; and two cases were operated on the same afternoon. The fact that nearly all of the cases which we see early are referred by younger men who have had special training in paediatrics promises well for a still further decrease in the operative mortality in the future.

In this series there were twenty males (59 per cent.) and fourteen females (41 per cent.) which corresponds with the published statistics. For the privilege of reporting these cases I am indebted to Doctors Hodge, Jopson, Lee, Speese and Brown.

Brown in his paper<sup>1</sup> referred to a method of incising the constricted ring of the intussusception which he used when reduction was impossible and when the bowel was not gangrenous. For details of this, those interested are referred to that paper.

I wish here to put on record, with Doctor Brown's permission, one case in which he successfully used this method: The patient, a five months' old male, was admitted in good condition, with a tumor palpable by rectum. The symptoms were of two days' duration. At operation the intussusception was not reducible, and as the bowel was not gangrenous, a longitudinal incision was made in the anti-mesenteric border of the cæcum, releasing the constriction. The intussusception was reduced, the incision was sutured and the patient made a normal convalescence. O. D. Johnson<sup>2</sup> has since reported a somewhat similar procedure. In a two-year-old child where complete reduction was not possible, it was accomplished by a longitudinal incision which penetrated only the serous and muscular coats of the bowel.

Our knowledge of intussusception is of long standing. John Hunter<sup>3</sup> ably described the mechanism and anatomy of intussusception. Paul Barbette,<sup>3</sup> a surgeon of Amsterdam, in 1676, definitely suggested opening the abdomen in obstinate volvulus or intussusception. In 1871, Jonathan Hutchinson<sup>3</sup> successfully treated intussusception by laparotomy. In 1888, A. E. Barker put the treatment on a rational basis by recommending early operation.

Resections were not favorably looked upon, for C. H. Fagge,<sup>4</sup> in 1906, said: "I believe there is no recorded case of recovery under one year." Soutar, in a lecture on "Intussusception" republished in the British Medical Journal in 1913 said, "Resection is

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attractive but unjustifiable unless gangrene is present, for there is no recorded case of an infant under one year surviving this operation."

W. H. C. Romanis<sup>5</sup> in 1918 wrote: "If, however, an irreducible intussusception occurs in a younger child, one or two years of age, the outlook is altogether different, for recovery is practically unknown in a child of this age and the operation is well regarded as hopeless.

C. W. Peterson<sup>6</sup> in 1905 reports the first successful resection in intussusception in this country. The earliest case was reported by Clubbe in 1896.<sup>3</sup>

In 1910, Fairbanks and Vickers<sup>7</sup> performed a successful resection for intussusception in a child of seven months.

In 1912, Charles Dowd<sup>8</sup> of New York resected about one-third of the colon, and performed a side-to-side anastomosis for irreducible (not gangrenous) intussusception in a child five days old. This is the youngest case that we have been able to find, where resection was successfully done for intussusception, and it occurred to the writer that the type of operation suggested by Brown might have been applicable in this case, since the bowel was not gangrenous.

Jopson, in 1916, reported a successful resection and anastomosis of the bowel, in a child seven months old, by means of a Murphy button.

In 1921, Clubbe<sup>3</sup> had collected sixteen cases of recovery after resection, and since that time other cases have been reported.

We believe at every operation for intussusception facilities should be at hand to perform resection should it be found necessary, for in the last thirty-four intussusceptions in the Children's Hospital there have been three resections with two recoveries.

The case to be reported, G. W. H., Jr., a seven weeks' old white male, was admitted to the Children's Hospital on October 19, 1925, to the service of Doctor Lee.

The chief complaint was vomiting and bloody stools. The family history was unimportant, and the child was a full-term, breast-fed baby. He was well until thirty-six hours before admission, when he vomited and had a bloody bowel movement. Later he passed small amounts of blood. The child was well-developed, but acutely ill. A mass was palpable in the left lower abdomen, which was also palpable by rectal examination, 2 centimetres from the anus. Bloody mucus was present on the examining glove. Without delay, under ether anaesthesia, an incision, 7 centimetres in length was made just to the left of the mid-line. On opening the peritoneal cavity bloody fluid escaped, and a sausage-shaped mass about 18 centimetres in length was delivered into the wound. About 8 centimetres were reduced with difficulty, and, on further effort, the descending colon ruptured into its mesentery. The irreducible mass which consisted of the lower end of the ileum, appendix, caecum, ascending, transverse and most of the descending colon, was resected, the greater part of which was gangrenous. An end-to-side anastomosis was performed, the end of the lower colon or sigmoid was sutured to the side of the lower ileum, linen sutures being used throughout. After completion of the anastomosis it was noted that a portion of the pouch of the ileum distal to the anastomosis was becoming dark, due to insufficient blood supply, so an additional 3 centimetres of the ileum were resected and again inverted, the anastomosis having been high enough to permit this. A cigarette drain was inserted and the abdomen closed. The operation lasted about one hour. The child's condition was critical and stimulants were administered. Cultures from the abdominal fluid showed staphylococcus albus, diphtheroids, and bacillus vulgaris.

On the following day the child had no bowel movement and was very toxic. On the third day there was no vomiting and the child had several bowel movements. On the sixth day, when the drain was removed, there was some drainage from the incision, and some vomiting. The stitches were removed on the twelfth day and the wound gradually healed. The bowel movements, which were normal, averaged about three daily. The patient continued to gain in weight and was discharged on December 13, 1925, fifty-five days after admission. The child was seen again about two weeks later,

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in good condition and gaining in weight. As the family then moved, the patient could not be traced any further.

This was the most extensive successful resection for intussusception in a patient of this age that we have been able to find in our review of the literature.

### SUMMARY

(1) The surgical treatment of intussusception can be divided into three groups: (a) Easily reducible when no further surgery is indicated; (b) the irreducible, without gangrene, when we recommend the operation suggested by Brown; or the modification suggested by Johnson; (c) The irreducible and gangrenous, when we recommend resection and immediate anastomosis.

(2) Successful resection for intussusception is not so rare as is generally believed, and probably should be done more frequently before the bowel is subjected to too much trauma.

(3) The case reported, from our search of the literature, seems to be the most extensive successful resection for gangrene in intussusception yet reported in a child seven weeks of age.

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## MASSIVE RESECTIONS IN ACUTE MECHANICAL INTESTINAL OBSTRUCTION

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THIS series of experiments was suggested by a case seen last year at the Church Home and Infirmary, in which obstruction was due to a band of adhesions following a pelvic operation. Upon opening the abdomen of this patient, who had been obstructed for six days, it was found that the bowel wall at the point of obstruction showed marked gangrene. It was so badly damaged over a space of ten to twelve inches that we felt that even if enterostomy were done above this point, the patient would still die from peritonitis due to rupture of the bowel below it. Yet it was not felt that the patient's condition warranted any massive resection. Therefore, it was thought best to extra-abdominalize the gangrenous portion of the bowel together with enough bowel above this point to be sure of free drainage without rupture into the peritoneal cavity. This was done in a few minutes and the patient left the table with very little change in her general condition.

During her convalescence practically all the bowel on the abdominal wall sloughed off, leaving a terminal ileostomy. She was put on high-caloric diet and in general built up so that at the end of six or eight months she had gained considerable weight and was in very good condition, her convalescence as a whole having been quite smooth. At the end of ten months, lateral anastomosis was done with no difficulty and she again had an uninterrupted convalescence.

On looking back we felt sure that a quick resection of the length of the bowel which we had made extra-abdominal would not have embarrassed her chances on the operating table and would have hurried her convalescence even though we felt that she would not have stood the lateral anastomosis at this time.

With this case in mind it occurred to us that it would probably be much better in the average case of acute mechanical obstruction if resection of the damaged bowel was done far enough back to make a lateral anastomosis possible at the primary operation, if the patient's condition warranted such a procedure. Upon looking up the literature on this subject it was found that, while many men advocated resection of the bowel in such cases, the point of resection, as well as the exact type of case in which resection would be indicated, was very indefinite. If one looks through the reviews on intestinal obstruction, he will find that no account is taken of the age of the patient, the duration of the obstruction, the exact cause, exact position of the obstruction, and the general condition of the patient at the time of operation in computing mortality rates. Also, it is very seldom stated how much

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bowel was removed and never stated in exact terms how to choose the point for resection. As far as we can find there has been no exact experimental work done in this particular line. Scholefield<sup>1</sup> advocated "resection where practicable of any length of bowel seriously involved," but gave no experimental work to back up his suggestion nor any means of telling to what point the bowel was damaged. Murphy and Brooks<sup>2</sup> say: "In surgical treatment of cases of intestinal obstruction, that part of the intestine with a mucous membrane which has been so damaged as to permit of abnormal absorption should be resected rather than drained." But again they give no exact data to back up their statement. Considering these points, we thought it would be interesting to perform some exact experimental work to determine whether dogs would stand massive resections after having been obstructed for four or five days, so far as the actual operation is concerned, and to see if we could greatly reduce the mortality rate by this procedure. We felt also that it was essential to try to determine, with some degree of exactness, a method of telling where the bowel would stand resection and lateral anastomosis without the usual sequence of leakage and peritonitis. We thought that if the dogs would stand primary operating, we would have accomplished two very important principles: First, that we would have totally removed the damaged bowel together with its toxic fluid, thereby preventing the possibility of absorption and of leakage from late rupture which often follows after drainage, such as is accomplished through ileostomy. Secondly, that we would give free drainage to the loops above the point of obstruction without loss of fluids and intestinal secretions, which is at present considered one of the greatest contributing factors in death from obstruction following ileostomy. Of course, by this means we would also save the patient a second operation. Dr. H. B. Stone felt that the removal of the large segment of damaged intestine was much better than drainage if it could be accomplished. He thought that a large amount of toxin is contained in the damaged bowel wall and that this is rapidly absorbed following release of tension, and, therefore, could not possibly be influenced by ileostomy.

Accordingly, experiments were undertaken to determine these points, *viz.*, mortality with primary massive resection, a specific means of determining a point where resection is safe, and if there actually is toxin present in the damaged bowel wall.

*Experimental technic.*—Medium-sized mongrel dogs were used throughout the experiments and in the first series were given morphia grains  $\frac{1}{4}$  and intratracheal ether. Under sterile technic, the abdomen was opened through a right rectus incision, and the ileum transected eighteen inches above the ileocaecal valve. The ends were inverted by the Parker-Kerr method and reinforced with three silk mattress sutures. The centre mattress suture was left long on each of the ends so that the two inverted ends could be tied together to prevent intussusception. The abdomen was then closed in layers with silk and the dogs allowed to remain completely obstructed for periods of two, four, five, and in one case six days. Not much attempt was made to go beyond the five-day period because we were losing better than 50 per cent. of the dogs before we even had a chance to perform the second operation, and we felt that since our results on the dogs which

actually lived to undergo the second operation were 100 per cent., it was of no advantage to waste more dogs.

At the end of the chosen period the dog was again anæsthetized but given as little ether as possible and no morphia, because we lost four or five dogs on the table during the induction period. This gives a fair idea as to how sick they were at the end of five days. The abdomen was again opened through the same incision or sometimes through a left rectus and the point of obstruction exposed and brought out on the abdominal wall. Resection of segments of the damaged intestine was then carried out of anywhere from as little as eight to ten inches in some of the two-day dogs to as much as forty-six inches in one of the five-day dogs, depending upon the extent to which the bowel wall was damaged. Resection was done as quickly as possible by clamping the mesenteric vessels near their base and dividing them between clamps. By this means resection of the whole loop could be done in three or four minutes and with no apparent reaction on the part of the animal. We feel that this is an important point.

The open end of the resected intestine was then inverted by the Parker-Kerr method and well reinforced and a lateral anastomosis done under as careful aseptic technic as possible. Small rubber-shod clamps were used and closed as lightly as possible to prevent damage to the bowel wall, as we feel that infection plays a very large part in leakage of anastomoses following resection. The lumen of both segments of bowel was very carefully washed out with salt solution and then with ether, and after having laid one complete layer of sutures, instruments and dressings were changed and the bowel wall again washed with ether so that the second layer of sutures was fairly clean. In some of the earlier cases this was not done and the difference between the reaction around the anastomosis definitely proves that this was of value because even in some of the dogs that had gone five days the reaction was much less than that of the two-day series. The anastomoses were made with silk throughout. Following completion of resection and anastomosis, the abdomen was closed in layers with silk.

In Dogs S1 to 20 the diet was the regular kennel diet of bread and boiled lungs both before and after operation. In Nos. 21 to 30 an attempt was made to standardize the pre-operative and post-operative diet by feeding the dogs nothing but milk for three to four days before operation and for three weeks following operation. This was done because we were getting such irregular results. In the first stage some of the dogs died at forty-eight to seventy-two hours following obstruction, and from then on up to five days, so that the immediate mortality was running around 50 per cent., making it quite difficult to get dogs to live long enough to do the second stage, especially since some of the ones that lived five days were so sick that we lost them during induction anæsthesia. However, this change in diet did not seem to help any as the mortality remained the same.

TABLE I (PART I)  
*Immediate and Final Results of Massive Resections*

Dog Obstruction 4. Duration of obstruction—two days. Immediate results—lived. Length of resection—eight inches. Final results—lived; sacrificed thirty-one days post-operative. Length of bowel left—fifty-two inches. Condition—good.

Dog Obstruction 5. Duration of obstruction—two days. Immediate results—lived. Length of resection—ten inches. Final results—died five days later. Perforation; re-obstruction; kink.

Dog S2. Duration of obstruction—two days. Immediate results—lived. Length of resection—ten inches. Final result—died twenty-four hours later. Leak; peritonitis.

Dog S3. Duration of obstruction—two days. Immediate results—lived. Length of resection—eleven inches. Final results—lived; sacrificed twenty-six days post-operative. Length of bowel left—forty-six inches. Condition—good.

Mortality rate for Part I, 50 per cent.

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### PART II

Dog S4. Duration of obstruction—four days. Immediate results—lived. Length of resection—twenty-four inches. Final results—lived; sacrificed fourteen days post-operative. Length of bowel left—thirty-nine inches. Condition—good.

Dog S1. Duration of obstruction—four days. Immediate results—lived. Length of resection—twenty-one inches. Final results—lived; sacrificed twenty-four days post-operative. Length of bowel left—forty-eight inches. Condition—fair.

Dog Obstruction 7. Duration of obstruction—four days. Immediate results—lived. Length of resection—twenty-four inches. Final results—lived; sacrificed thirty-four days post-operative. Length of bowel left—forty-six inches. Condition—good.

Dog S5. Duration of obstruction—four days. Immediate results—lived. Length of resection—twenty-six inches. Final results—died eleven days post-operative. Reobstructed. Length of bowel left—thirty-eight inches. Condition—poor.

Dog S6. Duration of obstruction—four days. Immediate results—lived. Length of resection—thirty-five inches. Final results—lived; sacrificed thirty-three days post-operative. Length of bowel left—forty-three inches. Condition—good.

Dog S7. Duration of obstruction—four days. Immediate results—lived. Length of resection—thirteen inches. Final results—lived; sacrificed twenty-six days post-operative. Length of bowel left—forty-six inches. Condition—good.

Mortality rate for Part II, 16.66 per cent.

### PART III

Dog S9. Duration of obstruction—thirty-six hours. Immediate results—died; distemper; pneumonia.

Dog S10. Duration of obstruction—five days. Immediate results—lived. Length of resection—thirty-three inches. Final results—lived; sacrificed twenty-one days post-operative. Length of bowel left—fifty-six inches. Condition—excellent.

Dog S11. Duration of obstruction—five days. Immediate results—died; perforation of loop; peritonitis.

Dog S12. Duration of obstruction—five days. Immediate results—lived. Length of resection—seventeen inches. Final results—lived; sacrificed ninety days post-operative. Length of bowel left—seventy inches. Condition—excellent.

Dog S13. Duration of obstruction—three days. Immediate results—died; ruptured loop; peritonitis.

Dog S14. Duration of obstruction—five days. Immediate results—died; induction anaesthesia.

Dog S15. Duration of obstruction—four days. Immediate results—died; from obstruction; no pneumonia; no leakage.

Dog S16. Duration of obstruction—three days. Immediate results—died; distemper; pneumonia.

Dog S17. Duration of obstruction—four days. Immediate results—died; rupture of loop; peritonitis.

Dog S18. Duration of obstruction—five days. Immediate results—lived. Length of resection—forty-three and one-half inches. Final results—died; distemper and pneumonia fourteen days post-operative. Length of bowel, thirty inches. Condition—no inanition.

Dog S19. Duration of obstruction—three days. Immediate results—died; obstruction; lung and peritoneum clear.

Dog S20. Duration of obstruction—three days. Immediate results—same as S19.

Dog S21. Duration of obstruction—five days. Immediate results—died; induction anaesthesia.

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Dog S22. Duration of obstruction—five days. Immediate results—died; induction anaesthesia; no peritonitis.

Dog S23. Duration of obstruction—five days. Immediate results—lived. Length of resection—thirty-two and one-half inches. Final results—lived; sacrificed sixty-three days post-operative. Length of bowel left—seventy inches. Condition—fair.

Dog S24. Duration of obstruction—five days. Immediate results—died; induction anaesthesia; no peritonitis.

Dog S25. Duration of obstruction—five days. Immediate results—lived. Length of resection—forty-six inches. Final results—lived; sacrificed sixty-three days post-operative. Length of bowel—eighty-eight inches. Condition—fair.

Dog S26. Duration of obstruction—five days. Immediate results—died; obstruction; lungs and peritoneum clear.

Dog S27. Duration of obstruction—six days. Immediate results—died; ruptured loop; peritonitis.

Dog S28. Duration of obstruction—five days. Immediate results—died; obstruction; lungs and peritoneum clear.

Dog S29. Duration of obstruction—three days. Immediate results—died; gangrene; ruptured loop.

Dog S30. Duration of obstruction—six days. Immediate results—lived. Length of resection—thirty inches. Final results—died; fourteen days post-operative; emaciation; partial obstruction. Length of bowel left—forty-two inches.

### *Summary of Mortality Rates*

Series No.	Mortality Rate
(1) Two-day .....	50 per cent.
(2) Four-day .....	16.66 per cent.
(3) Five-day .....	00 per cent.

It will be seen from the above table that the percentage of mortality is in inverse proportion to what one would expect, being much higher in the two-day series than in the four- or five-day series. This, we feel, is due purely and simply to the fact that during the first few cases we had no definite means of telling where resection would be safe, and, therefore, made the usual error of not removing enough bowel, since in the dogs that died death was due to leakage and subsequent peritonitis. At this point, also, our careful technic of lateral anastomosis had not been developed. We did not think that it was necessary to go back and repeat these experiments to prove this point because, after having got 100 per cent. results in the five-day series, it was felt that our original idea was sufficiently substantiated. We do not think that there is any question about the fact that the improvement in our results from the two- to the five-day period was due entirely to improvement in our ability to recognize the point at which resection of the bowel is safe together with the improvement of our technic in doing the anastomosis. Probably the point of resection was the largest factor by far, but still the difference in reaction around the anastomoses where the usual technic was used and that where the careful technic was used was enough to justify the routine use of the latter. Another important point brought out is the fact that these dogs stood ether anaesthesia very poorly and morphia was definitely

## MASSIVE INTESTINAL RESECTIONS

contra-indicated. Probably avertin with nitrous oxide or ethylene or even local anaesthesia with a little ether would be much better in the clinical case.

Another very important point to be considered is how much bowel can be removed with safety to the patient from a nutritional viewpoint. It will be seen from the table that in some cases almost half the total length of the small intestine was removed from some of these dogs without much apparent effect on their nutrition post-operatively. However, this seems to be somewhat of a variable factor, as in the last two dogs of the five-day series only about one-third of the total length of the bowel was removed and these dogs had still not regained their normal weight after a little over two months following operation. This is about comparable to what is reported in the literature to be true of human cases where E. R. McGuire<sup>3</sup> reports removal of eleven feet with normal nutrition, with the exception of some early diarrhea following operation, and in reviewing the literature finds twenty-one cases reported where 300 to 524 centimetres were removed without fatal results. Therefore, as long as one stays under ten to eleven feet there need not be much fear of nutritional disturbance.

This brings us to the point of how to determine where resection of the obstructed bowel is safe. The more experiments we did the harder we felt this point was to determine with any degree of exactness. We felt that the best things to judge by were first, the ability of the bowel to contract when mechanically stimulated; that is, not only ability to contract but to contract completely, go into actual spasm. This spasm is readily induced by tapping the bowel with a clamp or pinching it or plucking it with the finger. It is important to notice whether this bowel at the height of its contraction comes down to the size that one would expect normal bowel to reach under similar stimulation, because this helps to determine the degree of oedema which is the best expression of the early reaction of the bowel to obstruction.

Secondly, the circulation of the bowel wall and the mesentery is very important. There should not be any oedema of the mesentery, and pulsations should be clearly seen and felt in the mesenteric vessels. The circulation in the bowel wall itself is best determined by its color during both spasm and relaxation. During relaxation a point should be picked where the color of the bowel wall changes from the dusky, non-glistening color of damaged circulation to a point as near the normal pinkish glistening color as possible. This point is very hard to determine as the change is a very gradual one and the normal color is never actually reached. One has to be governed by the comparison and by experience, together with the other points that we have brought out. The bowel wall at the point of resection when in the spastic stage should be nearly white in color showing that the capillaries are not thrombosed, since the blood is expressed from them by the force of the contraction. In obstructed bowel where the circulation is damaged and there is beginning gangrene, even though the bowel will contract it remains rather dusky in color, probably due to thrombosed capillaries.

Thirdly, we found that in suturing obstructed bowel wall the needle meets

increasing resistance as one goes from badly damaged bowel wall toward that which is approximately normal, and this is one of the tests that we use to determine a suitable point. We feel that this is due to oedema of the submucosa since this layer is the layer that causes resistance to the passage of the needle. This oedema is depicted in Fig. 2 later in the article. In doing the anastomosis there is always, even at the point of resection, some difference between the resistance to the passage of the needle through the wall of the upper and of the lower segment. This shows that even where anastomoses will hold and resection is safe this oedema still persists to some extent.

At this point the microscopical pathology of obstructed intestinal wall

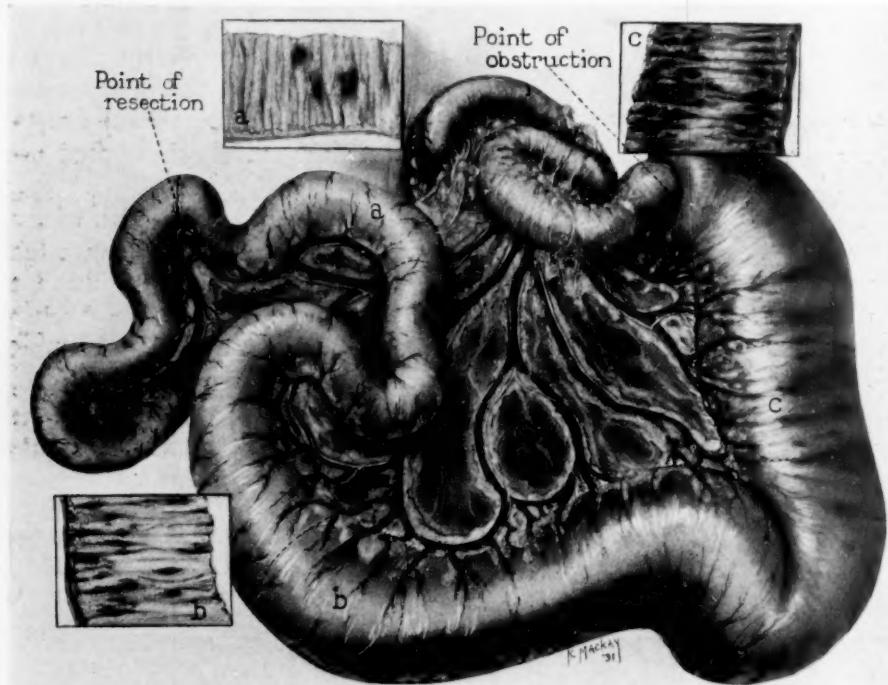


FIG. 1.—Dog S25. Showing condition of bowel at time of resection, five days completely obstructed.

might well be discussed. Fig. 2 is a microphotograph of segment C of Fig. 1. It shows, as can be readily seen, very marked oedema of all the layers of the intestinal wall but particularly of the muscular layers and of the submucosa with some slight cellular infiltration. We think that there is no question that this oedema, together with the very great increase in number of organisms in the lumen of the bowel, are the chief factors that have made resections leak following lateral anastomosis in such cases. It is certainly the failure to perceive these factors that has made mortality in these cases so high. If there is any uncertainty in the mind of the operator as to the point where this oedema and reaction have decreased to such an extent as to make resection safe, he had best by all means err on the side of safety and

## MASSIVE INTESTINAL RESECTIONS

make his resection several feet higher than there is any real necessity for, rather than to make it at a point of uncertainty. It is surely this combination of infection together with oedema around the sutures that allows leakage, and the leakage reacting in partially devitalized oedematous tissue that makes increased leakage ending in peritonitis and death. The contrast between badly damaged bowel and bowel where resection is safe is clearly shown in the difference between Figs. 2 and 3. In Fig. 3 there is very little oedema present so that in spite of the fact that the number of organisms in the lumen of the gut is probably the same in both cases, this bowel will hold sutures since its strength and circulation are good enough to overcome the invasion of the organisms. Because of these factors careful choice of the point of resection and careful technic in performing the operation are absolutely essential to success.

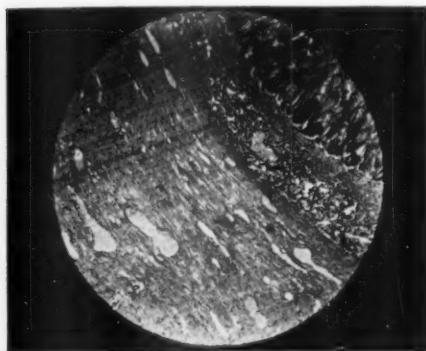


FIG. 2.

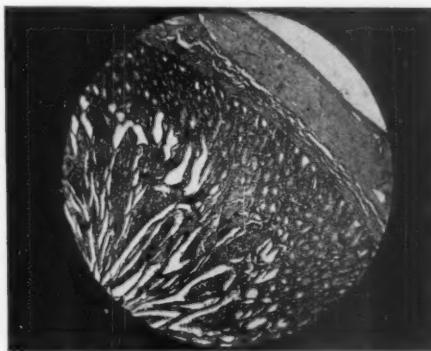


FIG. 3.

FIG. 2.—Microphotographs of sections taken from segment C of Fig. 1, showing marked oedema of whole bowel wall, but particularly of submucosa and muscularis.

FIG. 3.—Microphotograph of sections taken from segment A of Fig. 1, showing marked contrast of bowel wall at point of resection to bowel wall in Fig. 2. Very little oedema present.

TABLE II

### *Results of Intravenous Injection of Filtrate from Mucosal Scrapings*

Dog S31. Duration of obstruction—three days. Reaction (A) above—S31 (A); 10 cubic centimetres; mild; howled once; staggered; one spasm; urinated (lived). Reaction (B) below—S31 (B); no apparent reaction; lived.

Dog S32. Duration of obstruction—three days. Reaction (A) above—S32 (A); 10 cubic centimetres; marked reaction; passed water and faeces; howled; rolled over and over; unconscious for several minutes; staggered and very weak for five minutes; gradual return to normal (lived). Reaction (B) below—S32 (B); 10 cubic centimetres; no reaction of any sort; lived.

Dog S33. Duration of obstruction—three days. Reaction (A) above—S33 (A); 10 cubic centimetres; very marked general reaction. On the whole exactly as S32 (A). Died in twenty-four hours. Reaction (B) below—S33 (B). No reaction.

Dog S34. Duration of obstruction—three days. Reaction (A) above—S34 (A); 10 cubic centimetres; very marked general reaction. Died within twelve hours. Reaction (B) below—S34 (B). Equally marked general reaction; lived.

Dog S35—(Dog had been dead twelve to twenty-four hours.) Duration of obstruction—three days. Reaction (A) above—S35 (A); 10 cubic centimetres; marked

general reaction; lived. Reaction (B) below—S35 (B). Equally marked general reaction; lived.

To determine if there was actually any basis for the assumption that the oedematous partly devitalized bowel wall of obstructed intestine contains any toxin, the following series of experiments were performed. Five dogs were given morphia grains  $\frac{1}{4}$  and intra-tracheal ether, and under sterile technic a right rectus incision was made. They were then obstructed by transverse section of the ileum twenty-four inches above the ileocecal valve by the Parker-Kerr inversion of the ends, reinforced with mattress sutures of silk. The abdomen was then closed and the dogs allowed to remain obstructed for three days, at which time they were sacrificed and twelve inches of bowel taken from immediately above and twelve inches from immediately below the point of obstruction. This bowel was opened longitudinally and carefully washed through four washings of tap water. Then all the mucus and other material which had adhered to the mucosa was scraped off and the mucosa again washed through tap water. After this the mucosa was scraped completely off down to the sub-mucosa. The material thus obtained was ground in a porcelain mortar with twenty cubic centimetres of normal salt solution and allowed to stand fifteen minutes. The solution was then strained through gauze to get rid of the larger particles and the remainder centrifuged.

The same procedure was carried out on both segments of bowel in each of the five dogs. Ten cubic centimetres of the supernatant fluid were injected intravenously into each of ten dogs. The reactions of these dogs to the injection can be seen from Table II. It will be noted that on the whole the reaction is very much more marked in those dogs that received the solution obtained from extracted mucosa taken from above the point of obstruction both as to early and late results. While in the last two dogs the immediate reaction was practically the same in both cases, in the first case the dog receiving the extraction fluid from above the point of obstruction died, whereas the other lived, and in the last dog both reactions might be questioned because the dog from which the solutions were made had been dead from twelve to twenty-four hours.

No further experiments in this regard were attempted because we felt that the whole series was open to question in that it is practically impossible to exclude the chance of there having been some toxic material contained between and around the villi of the mucosa in spite of the careful washing process. It is now felt that it would have been better in view of the tremendous oedema and the increase in tissue fluid of the obstructed loops to have used the muscularis and sub-mucosa for the extraction process rather than the mucosa. This would have eliminated the chance of contamination from immersion in toxin to which the mucosa was subject. We feel that ample proof of the theory that toxin is actually present in the oedematous bowel wall has been obtained, but will later repeat the experiments with extracts from the muscularis and the sub-mucosa for our own satisfaction.

#### SUMMARY

It is interesting to note the remarkable variation in reaction of these animals to a perfectly stereotyped procedure, such as was done in obstructing them. They died in from three to six days, some showing marked gangrenous changes in the bowel wall with leakage in three days, others with no leakage or only beginning gangrene in five days. Attempt was made to standardize their intestinal contents by a routine diet, but with no effect on this factor

## MASSIVE INTESTINAL RESECTIONS

at all. This seems to be true of patients also, as some are quite sick in two to three days while others go six to seven days and still seem in fair condition.

We feel that in advocating massive resections, whenever possible, we are adhering to the surgical principle of ridding the body of tissue that is damaged beyond hope of repair, together with its toxic products of degeneration and the chance of generalized peritoneal infection through late rupture. We have also obviated the chance of abnormal absorption by such damaged tissue. We have shown why one must take out much more bowel than seems necessary at first glance, and have given a fairly exact means of determining the point at which resection is safe. It is proven that, in spite of the general belief to the contrary, large resections can be done on very sick animals with practically no reaction and a low mortality rate if they are done quickly. There seems to be much more danger from the anaesthetic than from the operation. Therefore we recommend a very light anaesthesia, one of nitrous oxide and avertin, or ethylene and avertin as probably being the best. No morphia should be given.

In cases where the patient is *in extremis* and it is impossible to pick a point for resection due to the marked distention of the bowel, we feel that the extra-abdominalization of the involved bowel as was done in the case suggesting this work offers the best chance of a favorable outcome. Ileostomy should be done only where it is impossible to find the point of obstruction through the original incision and the patient is too sick to stand further exploration.

We wish to extend our hearty thanks to Dr. Harvey B. Stone for his helpful suggestions in this work.

### CONCLUSIONS

- (1) Massive resections are feasible on very sick animals, giving a very low mortality rate if done quickly and with careful technic.
- (2) The point at which resection is safe can be determined with a fair degree of accuracy if the principles brought out are adhered to.
- (3) There is toxin present in the oedematous, partially devitalized tissue of obstructed intestinal wall.
- (4) Obstructed animals stand general anaesthesia very poorly.
- (5) Reaction to obstruction is an extremely variable factor.

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## CONGENITAL DUODENAL ADHESIONS\*

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FROM THE ST. CHRISTOPHER'S HOSPITAL FOR CHILDREN

IN 1925, Neff and Haden,<sup>1</sup> of St. Louis, called attention to transduodenal adhesions of congenital origin, when they reported the autopsy findings in three children who died of vomiting from unknown cause. In 1926, Higgins and Patterson,<sup>2</sup> of England, reported a similar condition in a child which recovered following operation.

Congenital duodenal adhesions are an important clinical entity having a definite train of symptoms, and should be borne in mind particularly by those called upon to operate on infants.

Though the cause of congenital duodenal adhesions has received investigation, no one seems to have advanced a theory which adequately explains their formation. The adhesions may be the result of infection which originates from intra-uterine sources, traveling through or along the umbilical vessels, falciform ligament or portal vein to the under surface of the liver or subhepatic fossa. The adhesions in the six cases herein reported all extended from the anterior surface of the duodenum to the under surface of the liver in close proximity to the gall-bladder. The duodenum was pulled upward and to the right, producing definite kinking. The portion proximal to the adhesions was distinctly dilated, and as the adhesions were severed, the gas was seen to pass into the distal portion. The stomach was dilated in each instance and this dilatation also was relieved after separating the adhesions.

The symptoms of congenital duodenal adhesions are so similar to those of hypertrophic stenosis that one is led to this as a diagnosis, and when at operation no stenosis is found, one should explore the subhepatic fossa for the presence of adhesions. Up to the present time no one has emphasized the importance of adhesions as a cause of these well-known symptoms.

The chief subjective signs are vomiting, constipation, and loss of weight in a fretful, hungry and dehydrated infant; while objectively there are visible gastric peristalses.

The vomiting occurs immediately after birth. In the early stages liquids are rejected almost as soon as they are swallowed, while as time goes on, the stomach becoming dilated, vomiting does not occur for some time after feeding, and then may become cumulative as well as projectile. Bile is usually absent in the vomitus in the early stages, but a small amount may pass the obstruction and then the vomitus will be bile-stained. The lack of absorption accounts for the constant hunger, the persistent constipation and the progressive emaciation and dehydration.

As the stomach dilates and the loss of weight continues, gastric peri-

\* Read before the Philadelphia Pediatric Society, February 10, 1931.

## CONGENITAL DUODENAL ADHESIONS

staltic waves become visible. Commencing in the left hypochondriac region, they pass across the epigastrium, culminating at the pyloric region. Occasionally, the waves may pass beyond, becoming lost under the liver. Since the stomach dilates slowly, early regurgitation rather than projectile vomiting is the rule.

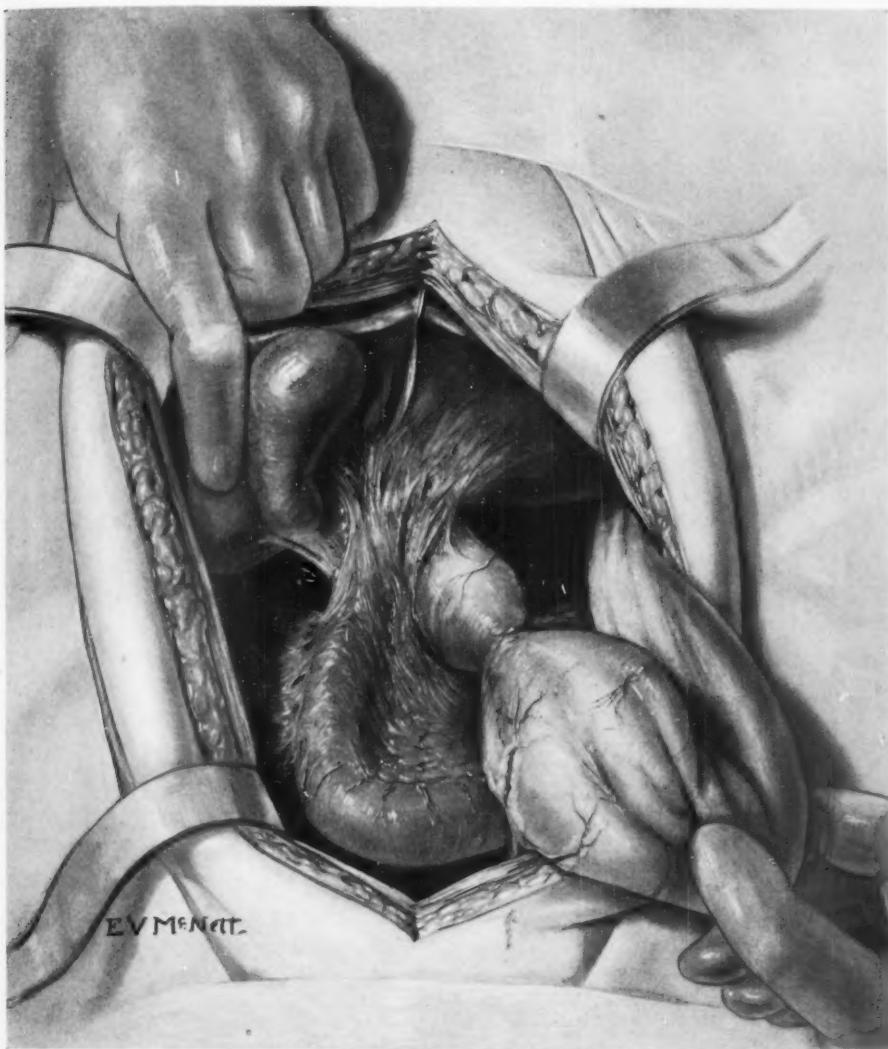


FIG. 1.—Stomach pulled downward and to the left, pyloric ring taut, duodenum dilated proximal to adhesions which pass from duodenum to under surface of liver.

Röntgen-ray examination is not essential for a diagnosis, and its findings may, in fact, be misleading.

The condition is to be differentiated from pylorospasm, pyloric stenosis, and atresia of the duodenum. In *pylorospasm*, the vomiting occurs several days after birth, is never bile-stained, and under small doses of atropine sulphate and thick feeding, the child is carried slowly back to recovery. In *pyloric stenosis*, the infant usually gains normally in weight, the vomiting

occurs a week to ten days or more after birth, is immediately projectile, is never bile-stained, and later becomes retentive; the peristaltic waves from the beginning are hour-glass in type and markedly visible, while in infants with congenital duodenal adhesions there is at first a slight general peristaltic wave which later may become hour-glass in type, but is not so marked as in the stenotic pylorus. *Atresia* of the duodenum is a congenital malformation and the diagnosis is usually made at operation or at autopsy.

The treatment of congenital adhesions of the duodenum is surgical, and should be instituted before dehydration sets in and loss of weight occurs, and it may be stated as axiomatic that the earlier the diagnosis is made and operation resorted to, the greater is the chance of success. In our series of six cases which recovered, one was four days old, one was five days old, and one eight weeks old. Of the cases which died, one was three weeks old, one six weeks old, and one eight weeks old.

The pre-operative treatment should be directed toward restoration of the water balance by giving normal saline solution hypodermically, intravenously or intraperitoneally. The extremities are wrapped in cotton and bandaged. Hot-water bottles are placed under and around the infant upon the operating table to preserve body temperature and lessen operative shock. All details incident to the operation are made ready before the anæsthetic is commenced. Ether, in my hands, has proven the most satisfactory, although many surgeons prefer local anæsthesia.

The operation is performed as follows: After the peritoneal cavity is opened, through an upper right rectus incision, the stomach is immediately identified, and delivered into the wound. The pylorus is examined for any hypertrophy; if none exists the subhepatic region is explored and the adhesions identified. The adhesions are better visualized by gentle traction of the stomach to the left by the assistant and with a retractor which pulls the hepatic flexure and transverse colon to the left, while the operator retracts the liver upward and to the right. When the duodenum is brought into view, the adhesions will be seen extending from the liver in close proximity to the gall-bladder transversely to the duodenum, and at the same time, the adhesions are made taut, divided with scissors and blunt dissection. As the adhesions are freed, and the obstruction released, one sees the distal duodenum fill, gas passes onward, and the proximal dilatation recedes. Accurate haemostasis is necessary, as the general surgeon who is not familiar with children's surgery is apt to think that minute bleeding vessels are capillary oozing and forget that these small vessels represent large and important ones in the adult. The wound is then closed in layers and dressings applied. The child is returned to a heated bed, placed in charge of a special nurse, and turned over to the pediatrician for further feedings.

In operating upon infants for pyloric stenosis and finding no hypertrophy present, one should explore the subhepatic fossa for the presence of adhesions as the possible cause of the symptoms. Likewise, in delivering the stomach in these cases, if one encounters difficulty in mobilization, adhesions should be immediately suspected.

## CONGENITAL DUODENAL ADHESIONS

The prognosis should be somewhat guarded, as uncontrollable oozing may develop and a reformation of the adhesions may take place.

The three deaths in this series, as shown by the following table, were late enough not to be considered operative deaths. They were all due to the reformation of adhesions, suspected in two cases and proven by autopsy in one. It is because of the liability of adhesions to reform that it is desirable to start early feedings in order to excite peristaltic waves. We have seen no cases with post-operative dilatation of the stomach from loss of nervous control.

### *Table Case Reports*

1921 CASE I.—Girl, white, aged eight weeks; weight, 6-10 pounds. Pre-operative diagnosis.—Pyloric obstruction. Post-operative diagnosis.—Duodenal adhesions. Result, died. Post-operative weight, 10-0 pounds. Cause of death.—Reformation of adhesions. Remarks.—Rapid gain in weight. Developed marked vomiting. Death two weeks after operation.

1925 CASE II.—Girl, white, aged six weeks; weight, 6-4 pounds. Pre-operative diagnosis, Pylorospasm. Post-operative diagnosis.—Duodenal adhesions. Result, died. Post-operative weight, 7-9 pounds. Cause of death.—Reformation of adhesions. Remarks.—Rapid gain, then gradual loss in weight; vomiting. Death sixteen days after operation. (Autopsy.)

1926 CASE III.—Boy, white, aged eight weeks; weight, 8-10 pounds. Pre-operative diagnosis.—Pyloric stenosis. Post-operative diagnosis.—Dudenal adhesions. Result, recovered. Post-operative weight, 9-1 pounds. Remarks.—Had slow convalescence. Gained weight slowly. Some vomiting continued for two weeks.

1930 CASE IV.—Boy, white, aged twenty days; weight, 6-12 pounds. Pre-operative diagnosis.—Pyloric stenosis and duodenal adhesions. Post-operative diagnosis.—Duodenal adhesions. Result, died. Post-operative weight, 8-11 pounds. Cause of death.—Reformation of adhesions (?). Remarks.—Patient did nicely for three weeks, then vomiting recurred. Rapid gain, then loss in weight. Death one month after operation.

1930 CASE V.—Girl, white, aged five days; weight, 7-12 pounds. Pre-operative diagnosis.—Pyloric stenosis. Post-operative diagnosis.—Duodenal adhesions. Result, recovered. Post-operative weight, 8-10 pounds. Remarks.—No vomiting. Slight regurgitation. Rapid gain in weight. Bowels normal.

1931 CASE VI.—Boy, white, aged four days; weight, 4-8 pounds. Pre-operative diagnosis.—Duodenal adhesions. Post-operative diagnosis.—Duodenal adhesions. Result, recovered. Post-operative weight, 5-12 pounds. Remarks.—No vomiting. Slight regurgitation. Gain in weight. Bowels moved normally.

### CONCLUSIONS

Attention has been called to a very important clinical entity, to which the term "congenital duodenal adhesions" is applied inasmuch as the affection has a definite train of symptoms, and if borne in mind and prompt surgical treatment is instituted, many infants that are now dying from vomiting of undetermined origin may be saved.

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## STRANGULATION OF THE SIGMOID FLEXURE BY THE PEDICLE OF AN OVARIAN CYST

BY FRANK C. BEALL, M.D.

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**CASE REPORT.**—A woman, twenty-three years of age, was admitted to the W. I. Cook Memorial Hospital of Fort Worth, at 8:00 P.M., January 26, 1929. She had retired at midnight the night before feeling perfectly well and was awakened at about 7:00 A.M. by a severe colicky pain in the lower part of her abdomen. She soon became nauseated and vomited. The pains, with occasional nausea and vomiting, had persisted throughout the day. During the day she had been given four enemas. Her mother, who had given the enemas, stated that she had used about a quart of fluid at each time and that the enemas had been taken easily and without special discomfort by the patient. They were expelled easily. At no time was any faecal matter passed. With the last enema there was a slight tinge of blood. There was nothing of importance in the patient's past history. Her temperature on admission was 99.4 degrees, pulse 116, and respirations 24.

On palpation just above Poupart's ligament on the left side a firm, rounded, sausage-shaped mass about 5 inches in diameter could be felt. The mass was fixed and extended from the symphysis pubis upward and outward close to and parallel with Poupart's ligament. Its upper limit could not be made out, the mass disappearing in the loin above the anterior superior spine of the ilium. The left flank was dull on percussion. Pressure over the mass caused slight pain. The abdomen everywhere else was soft and free from tenderness.

On bimanual examination of the pelvis, two masses could be felt, the tense, fixed, sausage-shaped mass on the left side and, in the right side of the pelvis, a freely movable, elastic, spherical tumor the size of a grapefruit. The latter had all the characteristics of an ovarian cyst. The fundus of the uterus was fixed in semi-retroverted position somewhat to the left of the mid-line.

The patient was operated upon fourteen hours after the onset of symptoms. The abdomen contained about two quarts of dark brownish-black fluid with a peculiar musty odor. The mass on the left side proved to be an enormously distended sigmoid, the two limbs of which were approximated and bound tightly together by the pedicle of a left-sided ovarian cyst which was wrapped tightly one and one-half full turns around the two limbs of the bowel so that the cyst lay in the right side of the pelvis. (Fig. 1.) The sigmoid, about 16 inches in length and about 5 inches in diameter, was tightly distended. It was of a dark purple, almost black, color except the longitudinal bands which had a pale, pearly appearance with a faint purple tinge. A sero-sanguineous fluid was exuding from the whole surface of the bowel wall. The ovarian cyst was about 4½ inches in diameter and had a blue, cyanotic appearance. Its pedicle was ribbon-shaped, about 5 inches long and about ½ inch in width with a fanning out at its two ends. This cyst on later examination was filled with a bloody fluid and contained a small intracystic papilloma covered by a single layer of columnar epithelium. The body of the papilloma had a dense fibrous structure and did not seem to correspond to the ordinary papillomatous cyst.

The pedicle of the cyst was ligated and cut near its origin on the left side and the cyst removed. By slightly mobilizing the descending colon, all of the gangrenous part of the bowel could be drawn outside the abdomen. The upper part of the rectum and the descending colon were approximated by two rows of plain catgut sutures, a rubber-tube

## STRANGULATION OF SIGMOID FLEXURE

drain placed into the pelvis through the lower angle of the wound and the wound closed snugly around the tube and the exteriorized bowel.

Three days after the primary operation, the gangrenous bowel was cut away close to the skin with an electric cautery. On January 2, 1930, a clamp was applied to the spur between the two limbs of the bowel. This cut through on January 8. At this time an examination with a gloved finger showed a lot of induration in the bowel walls around the site where the clamp had cut through. After this induration had cleared up, it

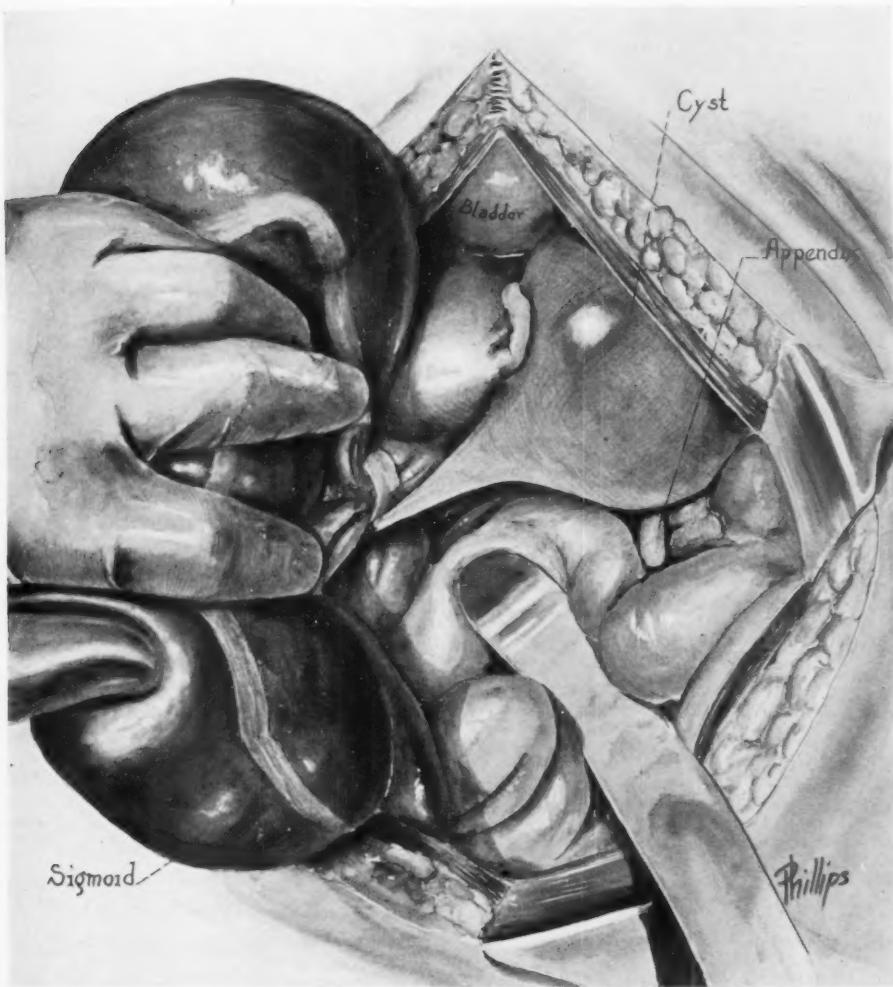


FIG. 1.—Condition as seen at operation.

seemed that the opening between the two limbs of the colostomy might not be sufficient, so a clamp was applied to the spur a second time January 24. This clamp came away January 30. February 7 with local anaesthesia and gas, after freeing the intestine to a certain extent, the colostomy was closed with a Connell suture of chromic catgut in an end-to-end fashion and the superficial tissues approximated over a soft rubber drain by through-and-through sutures of silkworm gut. There was no faecal drainage. The patient's bowels moved spontaneously eight days later and have moved regularly since—usually twice a day. She was discharged from the hospital ambulant, February 23, 1930.

THE TREATMENT OF ILEUS  
AS INDICATED BY CLINICAL EXPERIENCE AND EXPERIMENTAL STUDIES\*  
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THE treatment of acute intestinal obstruction is a challenge to the judgment and technical skill of any surgeon. The high mortality from this condition has stimulated intensive experimental researches over the last thirty years. It is my intention to briefly review the knowledge that has been gained from these studies; and to indicate any practical value we have found by the actual application to the treatment of acute intestinal obstruction in our clinic.

One of the most important advances is the recognition of at least three distinct types of dynamic obstruction. Much confusion can be avoided by taking cognizance of the differences between simple occlusions without damage to the blood supply or tissues; the rapid necrosis of strangulations; and possible combinations of these two states. The first of these forms is well illustrated by pyloric stenosis; the second by strangulated hernia; and the third, by adhesions obstructing a small bowel loop which cannot be emptied because of torsion or some other factor. We will return to this discussion later.

It has been found that the normal small intestinal mucosa provides an adequate defense against the absorption of any of the more toxic colloids. The simpler molecules of low molecular weight readily pass the barrier. There is thus a selective absorption which operates continuously to protect us from the many poison products of normal digestion. The poisons are either detoxified in passage through the bowel wall or are hurried along the intestinal canal and rendered inert by digestive enzymes. The normal mucosa is also impenetrable to introduced poisons of high molecular structure.<sup>1, 2, 3</sup> The normal bowel below an obstruction does not absorb the poisons from the obstructed loops when the obstruction is released. The normal small bowel contains small numbers of bacteria even in the higher segments.<sup>4, 5</sup> The continued loss of the normal secretions from the higher segments may lead to a very serious condition.<sup>6, 7</sup> The total loss of these secretions by vomiting or through a fistula for any length of time brings about a picture which closely parallels a high obstruction at the same level.<sup>8</sup>

When a small bowel loop is obstructed, there is an upset in the whole neuromuscular mechanism at least down to the obstructed point. On the motor side, peristaltic waves, originating above, attempt to pass the contents beyond the obstruction. Their ineffectiveness leads to a disturbance of the normal gradient with reversed peristalsis and vomiting.<sup>9</sup> If vomiting keeps

\* Read before the New York Academy of Medicine, December 4, 1931.

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the involved bowel empty, the simple type of obstruction similar to pyloric stenosis is produced. If by kinking or twisting the involved bowel segments are prevented from draining, another sequence of events ensues, producing the third type of obstruction, a mixture of obstruction and strangulation. Obstructed undrained intestinal loops furnish ideal conditions for bacterial growth. *Bacillus welchii*, among other bacteria, is present in most cases and increases enormously in numbers.<sup>10, 11</sup> There is no escape for the trapped secretions. The absorption rate from the involved area is less than under normal conditions.<sup>12, 13</sup> In the higher segments accumulation of secretions is by no means slow. The intra-intestinal pressure rises quickly.<sup>14</sup> The bacteria cause putrefaction with liberation of gas, which helps increase the distention. The fluid content of the loops becomes very foul and toxic if absorbed. The toxic properties as a rule take more than thirty-six hours to develop; after thirty-six hours the contents become very toxic.<sup>15</sup> If the distention inside the lumen increases beyond a certain point, the capillary circulation is stopped. Ischaemia and necrosis result, especially in the capillary distribution along the anti-mesenteric border.<sup>16</sup> The shorter the trapped segment, the more dangerous is this intra-intestinal pressure.<sup>17</sup> The secretion rate in the upper segments is considerably greater than that in the lower small bowel. Consequently, a trapped high loop develops pressure more quickly than a similar low one.<sup>14</sup>

It is generally conceded that there is a toxæmia with strangulation. If the circulation is shut off, the picture is more acute and death is more rapid.<sup>17</sup> The shorter is the strangulated segment, the more rapidly fatal the outcome.<sup>17</sup> Infectious and toxic intestinal wall materials in strangulation go directly into lymph channels or into the general blood-stream.<sup>18</sup>

It has been long debated as to whether there is a toxæmia in the simple high obstructions. The evidence seems to be increasing that toxæmia has little part in this picture. There is, on the other hand, loss of fluids and salts, by constant vomiting. Death appears to be from dehydration, demineralization and starvation.<sup>19, 20</sup> Animals can be kept alive and in good condition for long periods by reintroducing the vomited material through an enterostomy below the obstruction.<sup>21</sup> The blood-chemistry change in animals with obstruction at a definite level is decidedly different from that in animals obstructed at the same level but maintained in salt balance.<sup>22</sup> There is a striking similarity in the clinical picture, blood-chemical changes and life expectancy in animals with simple high obstruction and those with complete fistula at the same level. The syndrome is due to a deficiency of essential secretions through loss from the upper gastro-intestinal tract.<sup>8</sup>

From a practical standpoint, however, it is the part of wisdom to regard every obstruction of the intestine as a potential strangulation with impending toxæmia until otherwise demonstrated. This is especially necessary when there is a chance for failure of drainage in sagging loops. Here, the opportunity for increased intra-enteric pressure makes it possible to develop necrosis and consequent toxæmia.

The nature of the toxins in intestinal obstruction has been the subject of much work. The present-day opinion is that there is no specific toxin in obstructed gut fluid that is the cause of death.<sup>23</sup> There are many poisons present as the products of normal digestion or putrefaction which may be effective. If all food and normal secretions such as bile, pancreatic and gastric juice be excluded from a loop, the secretion then formed in the lumen is not toxic either on intravenous or intraperitoneal injection.<sup>24</sup> The presence of bacteria is essential for the formation of toxins.<sup>24, 25</sup> When bacteria are excluded, even autolysis of an involved segment *in vitro* or *in vivo* will not elaborate sufficient toxin to kill the animals.<sup>25, 26</sup> No specific antibodies are produced by repeated intravenous injections of closed loop fluid.<sup>27</sup> This would indicate that the toxic principles are probably not of protein nature. Every known soluble complete protein may act at least to some degree as an antigen. The entire mass of cleavage products of a protein are not antigenic.<sup>28</sup> There is no increase in immunity or tolerance to intestinal obstruction after recovery from a previous obstruction.<sup>29</sup> As the toxin is not specific in nature, the use of Welch bacillus antitoxin in therapy is not of value.<sup>30</sup> The toxins are quickly formed in most closed loops.<sup>31</sup> Large amounts of closed loop fluid can be introduced into the normal intestine without effect.<sup>1, 2, 3</sup> There is no evidence that toxins circulate in the blood of animals or patients dying of intestinal obstruction. The blood of such animals can be transfused into normal animals without causing any symptoms.<sup>31</sup> It would seem that the toxins are rapidly fixed by the tissues and only minimal quantities ever circulate.

The evidence for the pathway of absorption of the toxins is rather indefinite. Minute quantities have been demonstrated in the blood in the agonal stages of the condition.<sup>32</sup> The mucosa theory has been difficult to prove by experiment.<sup>1</sup> Many investigators agree that there is no absorption except through an injured mucosa. This they consider more essential than the formation of the toxin.<sup>6, 17</sup> The importance of increased intra-intestinal pressure is coming more and more to be recognized. This leads to stasis, ischaemia, and focal necrosis exposing the vascular bed.<sup>14</sup> Toxins can be recovered under these circumstances from the thoracic duct.<sup>33</sup> It is known that the vascular bed of the peritoneum readily absorbs toxins of high molecular structure.<sup>34</sup> The fissures and gangrenous patches allow the toxic material to come in contact with the visceral peritoneum, offering thus another method of absorption without demonstrable peritonitis.<sup>14, 35</sup> Emptying a distended loop full of toxic material even by the slightest manipulation causes damage to the friable mucosa, haemorrhage, and absorption of toxin. If the loops are extraperitoneal in position, damage to them causes little effect except development of a fistula; if intraperitoneal, it quickly kills.<sup>35</sup> By preventing distention in a majority of instances toxæmia does not occur.<sup>24</sup> If pressure is taken off by aspiration of the loop, no toxicity develops and the level of the non-protein nitrogen does not increase in the blood. When normal circulation to the obstructed loop is maintained, toxins

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are not taken up, or, at least, not faster than they can be handled.<sup>23</sup> Mounting pressure within the bowel is very important in the absorption of toxins but delays the circulation and thus slows their dissemination.<sup>36</sup> Pilocarpine, even in small doses, hastens the fatal termination by increasing the fluid distention in experimental animals with small bowel obstruction.<sup>37</sup> Symptoms of intoxication which follow release of obstructions are due to damaging of the occluded loop and absorption there, and not from the healthy bowel below.<sup>35, 38</sup> If one strips the small intestine of a normal animal from above down the carotid pressure sinks but recovers again and in forty-five minutes returns to its normal. When the same thing is done after an ileus of twenty-four hours' duration, the blood-pressure sinks lower than normal and shows little tendency to return. A proportion of these animals quickly die.<sup>39</sup> There is ample proof that death in intestinal obstruction is not due to a septicæmia or to a peritonitis. Much experimental work has disproved these theories formerly held. The occurrence of either septicæmia or peritonitis must be regarded as a complication.

Simple occlusion without damage to the blood supply or tissues such as in pyloric stenosis, if long enough continued, leads to dehydration, alkalosis, and starvation. The dehydration and alkalosis are due to the loss of water and acid through vomiting. If the loss of acid from the body is so rapid that the balance in the blood cannot be maintained, alkalosis becomes inevitable.<sup>40</sup> Laboratory tests on the blood will show that there is progressive diminution of the chlorides, a corresponding rise in non-protein nitrogen, and a high carbon-dioxide combining power.<sup>7</sup> Administration of sodium chloride prolongs the life.<sup>7</sup> As long as the chlorides can be kept near the normal level, the other changes in the blood do not occur.<sup>41</sup> Other chloride salts cannot take the place of sodium chloride.<sup>42</sup> Water alone is not effective in therapy.<sup>43</sup> The importance in supplying sodium chloride is in replacing the sodium base. Without this base fluid is lost as fast as it is given.<sup>44</sup>

The problem of an early simple high obstruction, then, becomes one of maintaining the normal sodium-chloride level of the blood. If there is no dehydration and no alkalosis in consequence, it is often possible to carry patients for many days, even though the obstruction is not relieved. The general condition is such that it is then possible to attack the obstruction under favorable conditions. Toxæmia is in the background or does not exist in these early simple obstructions.

Strangulation, on the other hand, is an entirely different problem. Toxæmia is the paramount issue in this form of obstruction. Dehydration, alkalosis, and starvation are of little significance, if they exist at all. Many times there is no evidence of their existence although the patient is overwhelmed by toxins. A laboratory test on the blood will show a high non-protein nitrogen, although it is best not to wait for it. The blood chlorides and carbon-dioxide combining power of the blood will show little change. Administration of sodium chloride has no effect in this form of obstruction. The problem is to remove as rapidly as possible the offending segment which

is giving rise to the toxæmia. The danger of delay is that of an overwhelming absorption of toxins; or impending rupture with rapidly fatal peritonitis. If once the toxin is widely disseminated we have no remedy that is of any value.

Long-continued undrained obstructions form a third type of intestinal ileus which combines the features of both simple and strangulation obstructions. The long-neglected loops become heavy with a very foul secretion. Distention takes place until at times the small bowel becomes enormous. Capillary engorgement and stasis of the blood supply occurs. Focal necroses develop, especially along the anti-mesenteric border. The capillary loops are exposed to the toxic material in the lumen; selective absorption is no longer effective. A toxæmia develops rapidly. Focal patches of gangrene allow peritoneal absorption of toxins as well as that through the capillary bed; or an actual rupture may occur, causing a fatal peritonitis. In this type of obstruction, dehydration, alkalosis and toxæmia are all prominent features. The problem is to supply sodium chloride and water and to remove the obstruction with as little manipulative disturbance as is consistent. This type of obstruction calls for the most careful judgment on the part of the surgeon and the patient's life depends on the wisdom of his decisions. It is most frequently seen in the forty-eight to seventy-two hours after the onset of an obstruction. If this critical period is passed without toxæmia developing, it is an indication that the loops are being effectively drained through vomiting.

The clinical cases here presented will include ileus in all its forms as related to the small intestine only, and excluding pyloric and duodenal obstruction. Paralytic ileus, partial obstruction and obstruction to the large bowel will not be considered. The operations in this series were performed by fourteen different surgeons, members of the attending and resident staff.

When a patient enters the hospital with the symptoms of acute intestinal obstruction or develops them in the hospital, we make an effort to decide whether we are dealing with a strangulation, a simple obstruction or a combination of the two. It is not always possible to decide, but in such instance we proceed on the assumption that it is the worst form. We make our diagnosis on the history and clinical examination and do not depend on laboratory studies except for localization by the Röntgen-ray.

In the simple high obstructions our plan is to restore fluids and salt balance. There is no need for haste in this type of obstruction as exemplified by pyloric stenosis. We depend a great deal on the blood-chemistry reports and guide our treatment accordingly. When the balance is restored we relieve the obstruction. The group of cases most nearly representing the simple obstruction in this report is that of obstruction at the site of a gastro-enterostomy. When the operation has been done years before the diagnosis is not so difficult; but on a newly operated individual in whom some accident has occurred at the gastroenterostomy opening, it is diagnosed with great reluctance. There have been seven of these cases in our series with two

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deaths, a mortality of 28.5 per cent. There should be no mortality in this group. The fatalities were due to too late diagnosis in one patient following a resection for cancer of the stomach; and to a technical error with abscess formation in the lesser sac in the second. Enteroenterostomy usually relieves these patients promptly.

### *Simple High Obstruction*

#### *(Excluding Pyloric and Duodenal Obstruction)*

No. 6459, male, aged fifty-one years. Type of obstruction.—Posterior gastro-enterostomy with kink of distal jejunal loop. Time since onset.—Recent operation. Two weeks after operation. General condition.—Poor from prolonged vomiting. Anæsthesia and operation.—Gas and oxygen, ether. Enteroenterostomy. Result.—Well.

No. 10,502, male, aged sixty-nine years. Type of obstruction.—Posterior gastro-enterostomy. Adhesions about Treitz's fossa. Time since onset.—Old operation, eight years. Gradual onset two weeks. General condition.—Mitral lesion. Arteriosclerosis. Bladder obstruction. Non-protein nitrogen, 57. Anæsthesia and operation.—Scopolamine-morphine-local. Enteroenterostomy. Result.—Well. Remarks.—Enormous distention of duodenum.

No. 20,627, male, aged forty-five years. Type of obstruction.—Posterior gastro-enterostomy. Adhesions about Treitz's fossa. Time since onset.—Old operation. Six to eight hours only. General condition.—Good. Anæsthesia and operation.—Gas and oxygen. Release of adhesions. Result.—Well.

No. 44,904, female, aged fifty-four years. Type of obstruction.—Posterior gastro-enterostomy. Retrograde incarceration. Time since onset.—Recent operation, gradual for sixteen days. General condition.—Fair. Anæsthesia and operation.—Avertin. Enteroenterostomy. Result.—Well.

No. 47,737, female, aged thirty-six years. Type of obstruction.—Posterior gastro-enterostomy. Adhesions about Treitz's fossa. Time since onset.—Old operation. Gradual for seven days. General condition.—Fair. Anæsthesia and operation.—Avertin, gas and oxygen. Release adhesions. Enteroenterostomy. Result.—Well.

No. 18,151, male, aged thirty-eight years. Type of obstruction.—Pólya type anastomosis. Obstruction from abscess. Time since onset.—Old operation. Posterior gastroenterostomy, gradual obstruction complete. General condition.—Poor. Anæsthesia and operation.—Gas and oxygen, ether. Enteroenterostomy. Result.—Died. Remarks.—Abscess lesser sac.

No. 38,174, female, aged fifty years. Type of obstruction.—Posterior gastro-enterostomy with kink of distal jejunal loop. Time since onset.—Recent operation. Five to ten days post-operative. General condition.—Resected cancer of stomach. Anæsthesia and operation.—Gas and oxygen. Enteroenterostomy. Result.—Died.

In strangulations the administration of salt solution will not prove as valuable as in the simple obstructions. Here the ideal is to get the strangulated segment outside the peritoneal cavity, restoring the normal intestinal current as soon as possible. We usually do a direct end-to-end anastomosis when circumstances permit. In very desperate cases we have tried enteroenterostomy, the Mikulicz type of removal, or enterostomy alone.

There were twenty-two cases of strangulation in which there was massive necrosis of a segment of bowel. These consisted in three instances of gangrenous intussusceptions. In one, an adult with intussusception originating beside a polyp in the lower ileum, resection and end-to-end anastomosis produced a cure. Two died, one, a six months' baby brought in after three

days, too late for cure; the other, a seven months' baby who, after resection, was progressing favorably but succumbed to an accidental boric-acid poisoning. Four cases of mesenteric thrombosis all died when gangrene was present. One patient had a resection and end-to-end anastomosis. He was a seventy-year-old man who was in critical condition after two days of obstruction and there were thirty inches of necrotic ileum with a rupture of the appendix. Another man of fifty-five had endocarditis, infarction in various organs, and patchy necroses of the lower two feet of terminal ileum. An ileocolostomy was done to sidetrack the involved bowel, but the non-protein nitrogen of the blood was eighty-eight at the time of operation and he died from continued progress of his disease. A fifty-two-year-old man had his obstruction for four days and only an enterostomy was done which did not relieve him. The fourth patient was a seventy-five-year-old woman who had had obstruction for several days. She died six hours after entry without operation as she was in too critical condition to even consider it. Post-mortem examination showed mesenteric thrombosis. There were four cases of volvulus with massive gangrene, two about old adhesions; and two about Meckel's diverticuli. Three of these patients died. The two with volvulus about adhesions were too late for surgical help—coming in after three days and six days of obstruction respectively. In both instances the necrotic bowel was brought outside in a Mikulicz procedure without benefit. In one of the Meckel's diverticulum cases resection with end-to-end anastomosis was successful; in the other, there was, unfortunately, a second obstruction at the anastomosis. It was recognized too late. This death must be regarded as a surgical failure. Four cases of strangulated inguinal hernia had successful resections and anastomoses with cure. There were four cases of strangulated femoral hernia. Three were resected and anastomosed with cure; the fourth died after similar treatment. This death cannot be charged to surgery as the woman arrived after five days of obstruction with perforation, and a blood non-protein nitrogen of 75, too late for help. She had her operation under local anaesthesia but also had a complicating pneumonia post-operatively. In three cases of ventral hernia two resections were successful but the third patient died after operation in diabetic coma; an unavoidable death.

The two cases of partial necrosis were handled by inverting the gangrenous patches and reinforcing the involved area. Both recovered without incident.

#### *Strangulation—Massive Necrosis*

No. 7960, female, aged seven months. Type of obstruction—Intussusception. Time since onset.—Twelve hours. General condition.—Poor. Anaesthesia.—Drop ether. Operation.—Resection, end-to-end anastomosis. Result.—Died. Remarks—Boric-acid poisoning.

No. 42,217, male, aged six months. Type of obstruction.—Intussusception. Time since onset.—Three days. General condition.—Very poor. Anaesthesia.—Drop ether. Operation.—Resection, end-to-end anastomosis. Result.—Died. Remarks.—Too late.

No. 43,395, male, aged fifty-five years. Type of obstruction.—Intussusception, polyp. Time since onset.—Two days. General condition.—Very ill. Anaesthesia.—Gas and

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oxygen. Operation.—Resection end-to-end anastomosis. Result.—Well. Remarks.—Gangrene six inches ileum.

No. 14,301, male, aged fifty-two years. Type of obstruction.—Mesenteric thrombosis. Time since onset.—Four days. General condition.—Fair; non-protein nitrogen, 60. Anæsthesia.—Local. Operation.—Enterostomy. Result.—Died. Remarks.—Enterostomy; spinal; no avail.

No. 20,791, male, aged fifty-five years. Type of obstruction.—Mesenteric thrombosis. Time since onset.—Gradual, time? General condition.—Endocarditis, non-protein nitrogen, 88. Infarction of spleen. Anæsthesia.—Gas and oxygen. Operation.—Ileocolostomy. Result.—Died. Remarks.—Patchy gangrene twenty-four inches ileum; too late.

No. 23,108, female, aged seventy-five years. Type of obstruction.—Mesenteric thrombosis. Time since onset.—Several days. General condition.—Prostrated, oedema, bad heart, dyspnoea. No operation. Result.—Died. Remarks.—Died six hours after entry.

No. 33,844, male, aged seventy years. Type of obstruction.—Mesenteric thrombosis. Time since onset.—Two days. General condition.—Critical, auricular fibrill infarction of liver. Anæsthesia.—Spinal. Operation.—Resection, end-to-end anastomosis. Result.—Died. Remarks.—Thirty inches gangrene ileum; too late.

No. 4152, female, aged fourteen years. Type of obstruction.—Volvulus, about adhesions. Time since onset.—Three days. General condition.—Very bad, peritonitis. Anæsthesia.—Gas and oxygen; ether. Operation.—Mikulicz first stage. Result.—Died. Remarks.—No chance for surgery; thirty-two inches gangrene ileum.

No. 51,485, female, aged seventy-seven years. Type of obstruction.—Volvulus about adhesions. Time since onset.—Six days. General condition.—Obese, peritonitis, non-protein nitrogen, 75. Anæsthesia.—Ether. Operation.—Mikulicz first stage. Result.—Died. Remarks.—No chance for surgery—twenty-four inches gangrene.

No. 23,574, male, aged thirty-three years. Type of obstruction.—Volvulus about Meckel's diverticulum. Time since onset.—Twenty-four hours. General condition.—Poor, non-protein nitrogen, 85. Anæsthesia.—Gas and oxygen; ether. Operation.—Resection, end-to-end anastomosis. Result.—Died. Remarks.—Second obstruction at anastomosis.

No. 7055, male, aged eleven years. Type of obstruction.—Volvulus about Meckel's diverticulum. Time since onset.—Nine hours. General condition.—Fair. Anæsthesia.—Ether. Operation.—Resection, end-to-end anastomosis. Result.—Well.

No. 8411, female, aged fifty-one years. Type of obstruction.—Strangulated ventral hernia. Time since onset.—Nine and a half hours. General condition.—Obese; severe diabetes; mitral insufficiency. Anæsthesia.—Gas and oxygen; local. Operation.—Enterostomy above damaged loop. Result.—Died. Remarks.—Diabetic coma; blood sugar, 455.

No. 14,382, female, aged thirty-six years. Type of obstruction.—Strangulated ventral hernia. Time since onset.—Twelve to sixteen hours. General condition.—Obese. Anæsthesia.—Gas and oxygen; drop ether. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Twenty-four inches gangrene of jejunum.

No. 33,828, female, aged forty-nine years. Type of obstruction.—Strangulated ventral hernia. Time since onset.—Nine hours. General condition.—Extreme obesity; hypertension; asthma. Anæsthesia.—Spinal. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Six inches gangrene jejunum.

No. 6739, male, aged forty-three years. Type of obstruction.—Strangulated inguinal hernia. Time since onset.—Five hours. General condition.—Active pulmonary tuberculosis. Anæsthesia.—Local, gas and oxygen. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Eighteen inches gangrenous ileum.

No. 14,416, male, aged seventy-seven years. Type of obstruction.—Strangulated inguinal hernia. Time since onset.—Sixteen to eighteen hours. General condition.—Over 200 pounds, cyanosed, fibrillating. Anæsthesia.—Local. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Eight to ten inches gangrenous ileum.

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No. 30,050, male, aged forty-nine years. Type of obstruction.—Strangulated inguinal hernia. Time since onset.—Twenty-four hours. General condition.—Fair. Anæsthesia.—Ether; chloroform. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Eighteen inches gangrenous ileum.

No. 31,394, male, aged twenty-three years. Type of obstruction.—Strangulated inguinal hernia; reduced *en masse*. Time since onset.—Forty-eight hours. General condition.—Good. Anæsthesia.—Gas and oxygen; ether. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Ten inches gangrenous ileum.

No. 12,646, female, aged forty years. Type of obstruction.—Strangulated femoral hernia. Time since onset.—Ten hours. General condition.—Good. Anæsthesia.—Gas and oxygen; ether. Operation.—Resection, end-to-end anastomosis. Result—Well. Remarks.—Seven and a half inches gangrenous ileum.

No. 16,836, male, aged sixty years. Type of obstruction.—Strangulated femoral hernia. Time since onset.—Two to three hours. General condition.—Bad heart; asthma. Anæsthesia.—Local. Resection, lateral anastomosis. Result.—Well. Remarks.—Nine inches gangrenous ileum.

No. 24,613, female, aged forty-eight years. Type of obstruction.—Strangulated femoral hernia. Time since onset.—Five days. General condition.—Bad; peritonitis. Anæsthesia.—Local. Operation.—Resection, end-to-end anastomosis. Result.—Died. Remarks.—Six inches gangrenous ileum; died pneumonia.

No. 30,659, female, aged forty-six years. Type of obstruction.—Strangulated femoral hernia. Time since onset.—Four days. General condition.—Fair. Anæsthesia.—Gas and oxygen, ether. Operation.—Resection, end-to-end anastomosis. Result.—Well. Remarks.—Eight inches gangrenous ileum.

### *Focal Necrosis*

No. 34,720, male, aged one month. Type of obstruction.—Strangulated inguinal hernia. Time since onset.—Twenty-four hours. General condition.—Poor; malnutrition. Anæsthesia.—Ether. Operation.—Infolding necrotic area; release obstruction; repair. Result.—Well.

No. 49,204, female, aged forty-five years. Type of obstruction.—Strangulated femoral hernia. Time since onset.—Two and a half hours. General condition.—Good. Anæsthesia.—Local. Operation.—Release obstruction; infolding necrotic area. Result.—Well.

The largest number of intestinal obstructions combine the features of obstruction and strangulation. And it is to this type of obstruction that the facts determined by experimentation are most applicable. In no other kind of surgery, also, is there so much opportunity for the display of surgical judgment. In many instances the margin of safety is so small that the slightest mistake will tip the balance the wrong way. The essence of surgical success consists in doing as little as is necessary to relieve the obstruction. Among the reasons for early operation may be urged the following: There is less shock and toxæmia in handling the less dilated loops. There is less distention and the loops are not so much in the way. There is less danger of an obstructed circulation. There is less danger of rupture from manipulation. There is less dehydration and loss of salts. The patient is in better shape to more safely stand the operation. The one thing a surgeon must constantly guard against is the lure to go on doing just a little more in a complicated case. Each case is a problem in itself and no set rules can be applied. The salt and water balance should be restored and the obstruction released or side-tracked as may seem expedient. The operation should be

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performed as quickly as is consistent with good surgery. The obstructed loops should be handled as little as possible. There is good evidence that this is a dangerous procedure. For this reason it is safer to seek out the collapsed loops and trace them upwards toward the obstruction rather than working from the obstructed loops downwards as is usually taught. When once the distention has been relieved in the involved bowel we think that surgery has accomplished all that is possible. The rest of the treatment is supportive with the hope that too great a toxæmia has not already been established. We do not fear absorption of the retained bowel secretions when the tension has been released. We think that stripping the bowel is

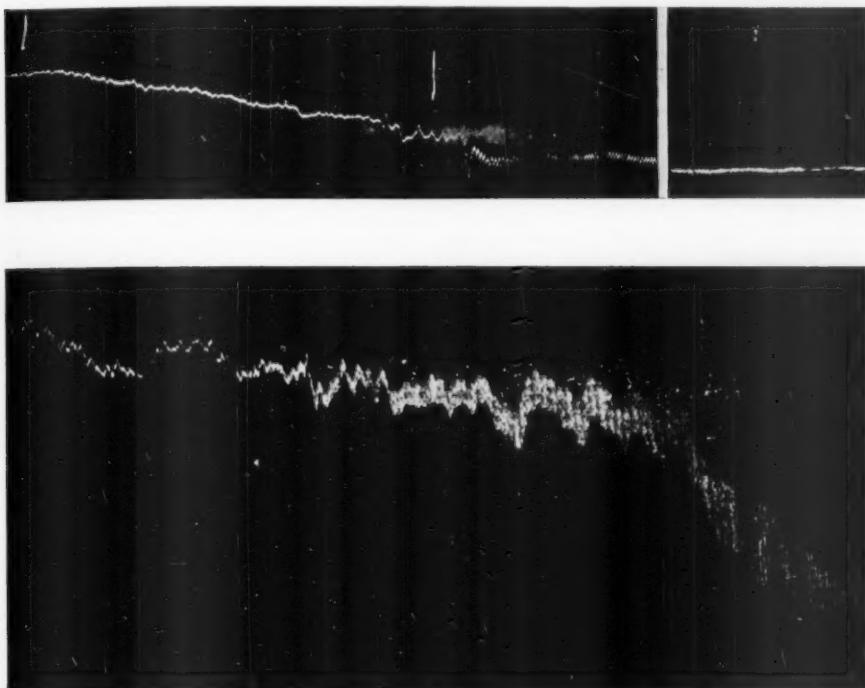


FIG. 1.—When the contents of the obstructed bowel are emptied by "stripping" the bowel between the fingers, there is a marked fall in blood-pressure in experimental animals. (Illustration reproduced from Lawen's article. *Zentralbl. f. Chir.*, vol. liv, p. 1037, 1927.)

a very dangerous procedure and have evidence that it acts the same in human cases as it does in animals. (Fig. 1.)

No. 27,172. H. D., aged thirty-eight years, was admitted to the Strong Memorial Hospital, August 17, 1929, following an automobile accident in which he received an injury to the head. He struck his abdomen on the steering wheel. On admission the only finding was a laceration of the scalp. The day following, there was soreness of the neck and abdominal muscles and he felt quite ill. Two days after the accident, he complained of having a few cramps in the upper abdomen and of distention. He was relieved by an enema. Distention and cramps became worse and he had difficulty in voiding.

Examination showed generalized abdominal tenderness, not very severe; also moderate distention with no evidence of shifting dullness. There had been two normal bowel movements on this day. The white blood count was 15,000. It was decided to

explore the abdomen, because his pulse was gradually rising. Exploration was done on August 20. Turbid fluid was found in the abdomen. The bowel was greatly distended. In the right lower quadrant, there was a mass which turned out to be strangulated terminal ileum, the bowel having passed through a small tear in the mesentery. The appendix, which was caught in this strangulation, was gangrenous. The appendix was removed. A tube was placed in the intestine and the dilated bowel was emptied of its contents. The patient was greatly shocked by this procedure. His blood-pressure

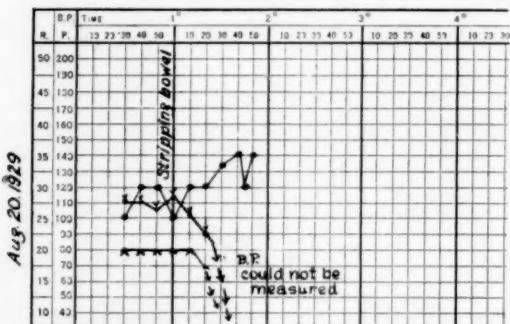
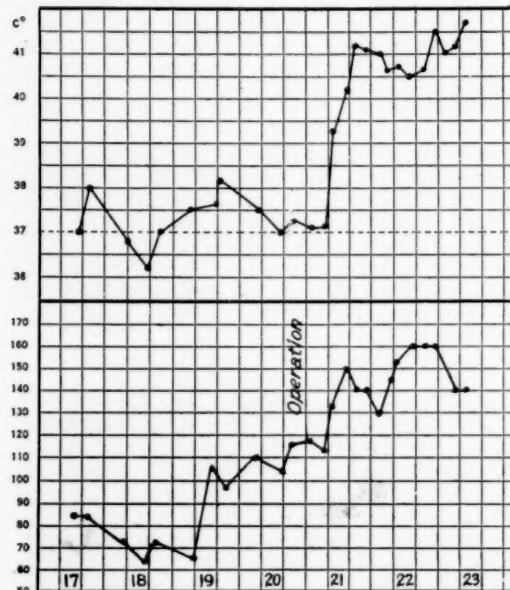


FIG. 2.—The same effect is noted in the human subject when the bowel is similarly "stripped."

dropped until it could no longer be obtained. Following stimulation and intravenous treatment, by the next morning he had revived somewhat. His temperature rose steadily, and also the pulse rate. Saline was administered in large quantities but blood chlorides dropped to 400. The blood non-protein nitrogen rose to 68 the day following operation and the blood-pressure remained low. In spite of the fact that he was given 5,000 cubic centimetres saline daily, the blood chlorides dropped to 316 and the blood non-protein nitrogen rose to 117. On August 23, he became comatose and died. (Fig. 2.)

No. 7150, J. C., a sixty-one-year-old man, was admitted to the Strong Memorial Hospital, May 21, 1927. He complained of distention and vomiting of four days' duration.

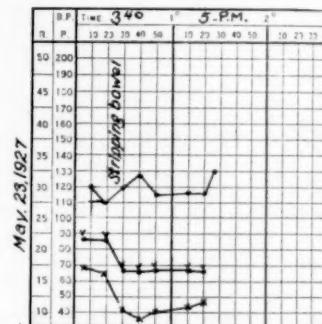
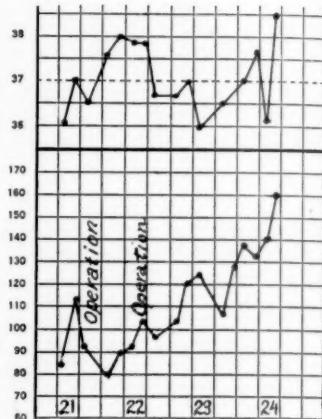


FIG. 3.—A second instance of the same reaction.

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The patient had a right inguinal hernia which came down four days before admission and could not be replaced. There was very severe pain about one and a half days later and the hernia had to be reduced about that time. The pain disappeared but vomiting persisted and became faecal in type. He appeared extremely ill and toxic. His abdomen was distended. There was visible peristalsis. The hernia was not down. The ring was dilated but otherwise there were no positive findings. His blood non-protein nitrogen was 85 and blood chlorides were 395. He was taken to the operating room one hour after admission, having had a saline infusion. An enterostomy was done under local anaesthesia. He was relieved and appeared considerably improved for about twelve hours. The following day he appeared to be worse and his blood non-protein nitrogen was 127 and blood chlorides were 372. A second operation was performed, at which time the obstructed small intestine was opened and the contents emptied through a tube. Although there was marked local improvement in the color and tone of the bowel, the blood-pressure dropped following this procedure and the condition became decidedly more critical. He continued to grow worse and on the day following he died. The final non-protein nitrogen reading was 182. (Fig. 3.)

We believe that simple enterostomy occasionally tides over a crisis until the real problem can be handled, but at best it is only a makeshift operation. In general, the more perfectly an enterostomy functions the worse it is for the patient. When there is a complicating peritonitis present, we are convinced that enterostomy has been a bad operation in our hands. There is resolution quickly in the region of the enterostomy so that the tube does not stay in place long. The opening becomes larger and a fistula develops, which is as bad itself as a high obstruction in that there is no control over the loss of essential secretions. The skin becomes excoriated. Local abscess may develop. In several instances resection with anastomosis has been necessary.

No. 18,198, J. B., a man of forty-two years, was admitted to the Rochester Municipal Hospital, September 20, 1928. He was taken to the operating room, where a ruptured appendix was removed. There was generalized peritonitis present at the time. Following the operation he was very distended, so much so that there was considerable respiratory embarrassment. A duodenal tube was inserted and left in place, but no improvement having occurred in three days an enterostomy was done under local anaesthesia. The blood non-protein nitrogen was 43 and chlorides were 473, with carbon-dioxide combining power of 55 per cent. Twelve days following this a pelvic abscess was drained. During all this time there was distention, which by October became quite severe. At the drainage of the abscess, it was noted that the small bowel was all bound in a mass of adhesions which apparently accounted for the distention. Three weeks following this, the infection having subsided, the small bowel during all this time having drained through an enterostomy, operation was performed for release of adhesions. This was done under gas-oxygen anaesthesia. The patient continued to go downhill, although his bowel now passed material, and it was decided that it was due mainly to the fistula at the old enterostomy site. Through this place the patient lost repeatedly tremendous amounts of fluid which excoriated his whole abdominal wall. Nevertheless, on November 12, 1928, the fistula in the jejunum was resected, and an end-to-end anastomosis was performed. All incisions healed up nicely and he gained both in strength and weight, so that three weeks following closure of the jejunum he was allowed to be up. He was discharged to the surgical Out-Patient Department and warned against eating heavy meals or anything with a large residue. This was carefully explained to the patient and a smooth diet given to him.

Nine days after discharge from the hospital, he took a very heavy meal and was suddenly seized with acute abdominal cramps. He entered the hospital again on Decem-

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ber 19, 1928, where it was evident that there was another acute obstruction. The blood non-protein nitrogen was 41.5 and chlorides were 480. At operation two tremendously dilated loops of bowel were found twisted around adhesions at the site of the old enterostomy. The volvulus was untwisted, the adhesions were excised and his recovery was uneventful. On June 26, 1931, he had a repair of a ventral hernia done. He has had no further trouble with intestinal obstruction since the operation in 1928. On November 21, 1931, he reported to the follow-up clinic. There were no complaints.

We now get relief in these cases by an inlying duodenal tube kept in place for gravity drainage for periods of twelve to eighteen hours. And we do not hesitate to attack the real seat of obstruction in the pelvis, even though it be necessary to open an infected area to do it. The collapsed ileal loops are traced down and the adhesions released.

The choice of anaesthesia is very important. The surgeon now has a considerable number of anaesthetics at his disposal. Spinal anaesthesia, nitrous oxide and oxygen supplemented by local anaesthesia, ethylene and local anaesthesia, all have their places and contraindications. Ether and chloroform are to be avoided if possible. The basal anaesthetics, avertin and sodium amytal, when reinforced by nitrous oxide, may also find a place.

We have had seventy-four patients who had obstructions which could be classed in this group. There were thirteen obstructed inguinal hernias with two deaths. One patient died from a *Streptococcus viridans* septicaemia; and the other had a paralytic ileus following reduction of his two-day obstructed hernia by an outside physician. In the hospital he had what we now consider a poor surgical procedure—stripping the bowel of its contents. Five obstructed femoral hernias were released and recovered without incident. In six cases of ventral hernia there were three deaths, a type of hernia which occurs in bad-risk patients even when uncomplicated by obstruction.

One extremely obese woman of seventy-five years had paralytic ileus, following release of her obstruction, necessitating secondary wound closure on the thirteenth day. At autopsy there was an abscess of the left lung, bronchopneumonia, and chronic myocarditis. A sixty-nine-year-old man entered with an obstructed hernia through an old appendix scar. It was sixty hours since the obstruction had occurred and he died in the operating room following a simple release of the obstruction under local anaesthesia. This patient was overwhelmed by his toxæmia and nothing could have saved him. The third fatality occurred in a 225-pound, fifty-three-year-old woman who had an obstructed ventral hernia the size of a football. She had been obstructed for twenty-four hours but refused operation for another twelve hours. She then asked for operation but it was too late to be successful. An internal hernia into the lesser peritoneal sac in a three-day-old baby was freed and the patient made an uninterrupted recovery. In three patients with herniation through tears in the mesentery there were two deaths. One patient entered the hospital eleven days after the onset of his trouble and although the bowel was released and appeared viable, he became worse and died with a general peritonitis.

The second fatality was in a man who had a tear through the mesentery in an accident. The hugely distended bowel was emptied of its contents through a Paul's tube. He never recovered from the shock of this procedure. In the third case a tremendously dilated loop could not be delivered through the rent but the operator performed a lateral anastomosis between the distended and collapsed loops nearest to the torn mesentery. Recovery was uninterrupted. The segment was resected successfully

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at a later operation. In one case of obstruction due to the passage of a large gall-stone which had ulcerated through, too much surgery was necessary to complete the operation. The patient was unable to stand it in her precarious condition. Three cases of intussusception were reduced and recovered without complication. One patient with apparent mesenteric thrombosis, whose symptoms indicated an extension upward from a pelvic peritonitis, made a recovery after simple enterostomy. The bowel was a Concord grape color but it must have been viable because it resumed its function after a very precarious convalescence. We cannot account for this recovery and regard it as a miracle. In nineteen patients who had obstruction about old adhesions or bands in the peritoneal cavity, there were four deaths. In one patient, a woman of seventy-four, the condition was critical at entry. She had been obstructed three to four days. The non-protein nitrogen of the blood was 88 and the chlorides 398 at the time of admission. A low enterostomy was done under local anaesthesia but it was of no avail. The second death occurred in a girl of five who was admitted twenty-four hours after her obstruction in rather precarious condition. She did not survive simple release of the obstructing band. There was enormous distention of the small bowel and apparently absorption of toxins had overwhelmed her. In the third case, a surgical error must be held as responsible for the death. This man of fifty-four had a definite band across his terminal ileum which was released. The operator then traced back the bowel to what he supposed was Treitz's ligament. At autopsy this band turned out to be a band obstruction across a high jejunal loop. The bowel above was distended and death had occurred through rupture of a necrotic patch and peritonitis. The fourth fatality was in an eighty-four-year-old woman, with generalized carcinomatosis. The obstructed small bowel had been drained through an enterostomy. The patient's family wisely refused operation for relief of the obstruction with such a hopeless prognosis ahead.

In twenty-one patients with acute peritonitis complicated by obstruction, there were five deaths. Many of these obstructions came on while the patient was convalescing from some acute visceral perforation. In this type of patient diagnosis is difficult, and usually operation is delayed as the surgeon hesitates to reopen the abdomen in the presence of peritonitis.

We have learned to differentiate these patients with obstruction on a dynamic basis from those with paralytic ileus and now no longer hesitate to attack the obstruction at its source. We have practically abandoned enterostomy, which would seem to be the simplest therapy to offer these very ill patients. Two of our fatalities occurred in patients who had enterostomies as their only operation. One of these patients had a subhepatic abscess and bronchopneumonia at autopsy; the other, a girl of three years, had a pelvic abscess. We now look upon this treatment as inadequate and think these patients might possibly have been saved. Our third fatality in this group was in a man of forty-seven, who had a volvulus at operation five days after his original laparotomy. Paralytic ileus followed the untwisting of this segment and an enterostomy did not benefit him. The condition in the fourth patient was so desperate that the repeated efforts to rescue him from the multiple adhesions and fistulas were almost certain to result in failure. In his case the surgeon attempted more surgery than his condition would warrant. An organic obstruction which was not recognized until too late was responsible for the fifth death in this series. The patient had had a perforated gastric ulcer, a streptococcus peritonitis and a pelvic abscess, all of which served to mask the true cause of his symptoms. In the group of

patients with obstruction and peritonitis, there have been some amazing recoveries in what appeared to be almost hopeless conditions. We believe we have made more improvement in the treatment of this group than in any other form of obstruction.

It is very desirable that these patients, who undoubtedly have very irritable small intestines as a result of their peritonitis, be placed on a low-residue smooth diet; and perhaps should take mineral oil for several months. We are confident that a heavy meal with high roughage has brought on acute obstructions in two instances in this series. (Cases 10,581 and 18,198.)

There have been 106 cases in this series with thirty deaths—28.5 per cent. mortality. An analysis of our fatalities indicates that seventeen patients came too late for any therapy—(54 per cent.); six patients died of conditions as complications or accidents beyond the control of the surgeon—(20 per cent.); diabetic coma; streptococcal septicæmia; pneumonia and lung abscess; boric-acid poisoning; refusal of surgery; too many obstructions and complication; seven deaths may be fairly charged against the surgery itself—(23.3 per cent.). In three very ill patients there was too late recognition of a surgical complication which might have been remedied. In one patient there was failure to recognize a second high obstruction. There was a technical error, allowing leakage from a suture line in one instance. And in two cases the operation, enterostomy, may be regarded as insufficient to have relieved the condition. In addition to this, there were probably four errors in judgment in critically ill patients. Two of these errors consisted in too much surgery; and the other two, in the choice of a procedure which is dangerous in itself and fundamentally wrong in principle.

#### *Combined Features of Obstruction and Strangulation Hernias*

No. 6030, male, aged fifty-three years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Four hours. General condition.—Good. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 7946, male, aged three months. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Six to eight hours. General condition.—Good. Anæsthesia.—Drop ether. Operation.—Release, repair. Result.—Well.

No. 24,902, male, aged seventy-two years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Five hours. General condition.—Fair. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 28,280, male, aged thirty-nine years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Ten hours +. General condition.—Good. Anæsthesia.—Gas and oxygen. Operation.—Release, repair. Result.—Well.

No. 28,940, male, aged eighty-one years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Eight to ten hours. General condition.—Fair. Anæsthesia.—Spinal. Operation.—Release, repair. Result.—Well.

No. 35,973, male, aged forty-two years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Four hours. General condition.—Good. Anæsthesia.—Spinal. Operation.—Release, repair. Result.—Well.

No. 36,553, male, aged fifty-nine years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Three and a half hours. General condition.—Cancer, stomach. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

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No. 40,976, female, aged fifty-seven years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Six hours. General condition.—Obese, good. Anæsthesia.—Spinal. Operation.—Release, repair. Result.—Well.

No. 43,510, male, aged eighty-three years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Three hours. General condition.—Arteriosclerosis, hypertension. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 50,465, male, aged eighty-seven years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Five and a half hours. General condition.—Good. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 51,923, male, aged seventy-eight years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—One and a half hours. General condition.—Good. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 7150, male, aged sixty-one years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Four days. General condition.—Bad, non-protein nitrogen, 123.5. Anæsthesia.—1, Local; 2, local. Operation.—Enterostomy; lateral anastomosis. Result.—Died. Remarks.—Contents stripped through tube.

No. 44,697, male, aged two months. Type of obstruction.—Obstructed inguinal hernia. General condition.—Bad. Anæsthesia.—Drop ether. Operation.—Release, repair. Result.—Died. Remarks.—One week post-operative died, streptococcus viridans septicæmia.

No. 12,088, female, aged fifty-two years. Type of obstruction.—Obstructed femoral hernia. Time since onset.—Five hours. General condition.—Obese; blood-pressure, 200/100. Anæsthesia.—Local, ether. Operation.—Release, repair. Result.—Well.

No. 21,528, male, aged seventy-eight years. Type of obstruction.—Obstructed femoral hernia. Time since onset.—Two days. General condition.—Bad, non-protein nitrogen, 100. Anæsthesia.—Scopolamine; morphine, local. Operation.—Release, repair. Result.—Well.

No. 23,162, female, aged fifty-two years. Type of obstruction.—Obstructed femoral hernia. Time since onset.—Fourteen hours. General condition.—Fair. Anæsthesia.—Local, gas and oxygen. Operation.—Release, repair. Result.—Well.

No. 33,491, female, aged sixty-three years. Type of obstruction.—Obstructed femoral hernia. Time since onset.—Seven hours. General condition.—Chronic nephritis, hypertension. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 43,507, male, aged forty-seven years. Type of obstruction.—Obstructed femoral hernia. Time since onset.—Six hours. General condition.—Diabetes. Anæsthesia.—Local, gas and oxygen. Operation.—Release, repair. Result.—Well.

No. 30,090, male, aged forty-two years. Type of obstruction.—Obstructed ventral hernia. Time since onset.—Six hours. General condition.—Good. Anæsthesia.—Gas and oxygen. Operation.—Release, repair. Result.—Well.

No. 33,213, male, aged forty-six years. Type of obstruction.—Obstructed ventral hernia. Time since onset.—Several hours. General condition.—Good. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 54,383, female, aged sixty-one years. Type of obstruction.—Obstructed ventral hernia. Time since onset.—Twenty-four hours. General condition.—Good. Anæsthesia.—Local. Operation.—Release, repair. Result.—Well.

No. 1145, male, aged sixty-nine years. Type of obstruction.—Obstructed inguinal hernia. Time since onset.—Sixty hours. General condition.—Desperate. Anæsthesia.—Local. Operation.—Release, repair. Result.—Died. Remarks.—No chance; too late.

No. 24,620, female, aged fifty-three years. Type of obstruction.—Obstructed ventral hernia. Time since onset.—Twenty-four hours + twelve hours. Refused operation. General condition.—Weight, 225 pounds. Very poor. Anæsthesia.—Ether. Operation.—Release, repair. Result.—Died. Remarks.—Patient waited too long. Hernia size of football.

No. 37,846, female, aged seventy-five years. Type of obstruction.—Obstructed

ventral hernia. Time since onset.—Five hours. General condition.—Extreme obesity. Anæsthesia.—Gas and oxygen, ether. Operation.—Release, repair. Result.—Died. Remarks.—Paralytic ileus; bursting wound; secondary closure; bronchopneumonia; lung abscess; chronic myocarditis.

No. 35,271, male, aged three days. Type of obstruction.—Internal hernia into lesser peritoneal sac. Time since onset.—Three days. General condition.—Fair, non-protein nitrogen, 74. Anæsthesia.—Drop ether. Operation.—Release. Result.—Well. Remarks.—Unusual case; recovered nicely.

#### *Old Adhesions*

No. 14,258, male, aged twenty-six years. Type of obstruction.—Old adhesions, appendix, post-operative. Time since onset.—Seven and a half hours. General condition.—Good. Anæsthesia.—Gas and oxygen. Operation.—Release two places. Result.—Well. Remarks.—Nine months after appendix operation.

No. 18,198, male, aged forty-two years. Type of obstruction.—Old pelvic adhesions; volvulus. Time since onset.—Five to six hours. General condition.—Good. Anæsthesia.—Gas and oxygen, ether. Operation.—Release. Result.—Well. Remarks.—Followed heavy meal; non-protein nitrogen, 41.5.

No. 22,507, female, aged sixty-three years. Type of obstruction.—Old band adhesions. Time since onset.—Three days. General condition.—Fair. Anæsthesia.—Gas and oxygen, ether. Operation.—Release, enterostomy. Result.—Well.

No. 22,508, male, aged thirty-nine years. Type of obstruction.—Old adhesions; several obstructions. Time since onset.—Two hours. General condition.—Fair. Anæsthesia.—Spinal. Operation.—Release several bands. Result.—Well. Remarks.—Eight months after acute peritonitis.

No. 24,529, male, aged forty-seven years. Type of obstruction.—Old adhesions previous gall-bladder operation. Time since onset.—Fourteen hours. General condition.—Good. Anæsthesia.—Gas and oxygen, ether. Operation.—Release. Result.—Well.

No. 25,589, male, aged twenty-nine years. Type of obstruction.—Old adhesions operative scar. Time since onset.—Forty-eight hours. General condition.—Fair. Anæsthesia.—Gas and oxygen. Operation.—Release. Result.—Well.

No. 26,978, female, aged forty-five years. Type of obstruction.—Old adhesions previous appendicitis. Time since onset.—Thirty hours. General condition.—Good. Anæsthesia.—Gas and oxygen, ether. Operation.—Release. Result.—Well.

No. 26,978, female, aged forty-six years. Type of obstruction.—Old adhesions, previous appendicitis. Time since onset.—Eighteen hours. General condition.—Good. Anæsthesia.—Spinal. Operation.—Release several bands. Result.—Well. Remarks.—Six months after previous entry.

No. 30,304, male, aged forty-eight years. Type of obstruction.—Metastatic cancer, adhesions pelvis. Time since onset.—Gradual, partial; two to three days, complete. General condition.—Fair. Anæsthesia.—Spinal. Operation.—Ileocolostomy. Result.—Well. Remarks.—Enormous loops; ileum bound firmly in carcinoma.

No. 31,698, female, aged twenty-one years. Type of obstruction.—Old adhesions, previous appendicitis. Time since onset.—Fifteen hours. General condition.—Good. Anæsthesia.—Spinal. Operation.—Release. Result.—Well.

No. 32,610, male, aged five years. Type of obstruction.—Old adhesions about old enterostomy. Time since onset.—Twelve hours. General condition.—Good. Anæsthesia.—Gas and oxygen, drop ether. Operation.—Release. Result.—Well. Remarks.—Old enterostomy opened, repaired.

No. 35,613, male, aged thirty-eight years. Type of obstruction.—Old adhesions about colon. Time since onset.—Several days. General condition.—Poor; non-protein nitrogen, 86; chlorides, 295. Anæsthesia.—Ether. Operation.—Release, enterostomy. Result.—Well. Remarks.—Condition critical, non-protein nitrogen to 101 post-operative.

No. 44,368, male, aged sixty years. Type of obstruction.—Adhesions two previous

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laparotomies. Time since onset.—Thirteen hours. General condition.—Good. Anæsthesia.—Ether. Operation.—Release band. Result.—Well.

No. 46,975, female, aged fifteen months. Type of obstruction.—Adhesions cong. or inflam. Time since onset.—Five days. General condition.—Critical, pulse 180. Anæsthesia.—Drop ether. Operation.—Release bands. Result.—Well.

No. 50,809, female, aged seventy-six years. Type of obstruction.—Old bands. Time since onset.—Twenty-four hours. General condition.—Very poor; hypertensive heart disease.—Anæsthesia.—Local, drop ether. Operation.—Release bands. Result.—Well. Remarks.—Non-protein nitrogen, 47.

No. 2710, female, aged seventy-four years. Type of obstruction.—Old pelvic adhesions. Time since onset.—Three to four days. General condition.—Critical. Anæsthesia.—Local. Operation.—Enterostomy (low). Result.—Died. Remarks.—Non-protein nitrogen, 88-115; chlorides, 398-450.

No. 3292, female, aged eighty-four years. Type of obstruction.—Old adhesions known cancer metastases. Time since onset.—Forty-eight hours. General condition.—Critical. Anæsthesia.—Local. Operation.—Enterostomy. Result.—Died. Remarks.—Non-protein nitrogen, 58; lived twelve days. Family opposed to further operation.

No. 24,919, female, aged five years. Type of obstruction.—Old pelvic adhesions. Time since onset.—Twenty-four hours. General condition.—Very sick, pulse 180. Anæsthesia.—Drop ether. Operation.—Release. Result.—Died. Remarks.—Tremendous distention small bowel.

No. 28,967, male, aged fifty-four years. Type of obstruction.—Old adhesions. Time since onset.—Gradual, partial; one to two days, complete. General condition.—Bad, hemiplegia, recent. Anæsthesia.—Ether. Operation.—Release bands at ileum. Result.—Died. Remarks.—Bands about jejunum, mistaken for Treitz's ligament.

### *Fresh Adhesions with Peritonitis*

No. 7116, female, aged nineteen years. Type of obstruction.—Pelvic peritonitis adhesions. Time since onset.—Gradual, complete one day. General condition.—Good. Anæsthesia.—Gas and oxygen, ether. Operation.—Release, enterostomy. Result.—Well.

No. 10,581, male, aged sixteen years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Gradual; two to three days complete. General condition.—Poor. Anæsthesia.—Gas and oxygen, local. Operation.—Release enterostomy. Result.—Well. Remarks.—Desperate type of case, appendicitis; four days post-operative enterostomy; one month post-operative, drainage pelvic abscess; two days later enterostomy; one month later release adhesions; enterostomy.

No. 13,872, male, aged forty years.—Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Gradual, one to two days complete. General condition.—Fair. Anæsthesia.—Gas and oxygen. Operation.—Jejunostomy; release. Result.—Well. Remarks.—Resection and anastomosis of jejunostomy necessary later.

No. 18,198, male, aged forty-two years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Thirty-six days post-operative; two to three days complete. General condition.—Fair. Anæsthesia.—Gas and oxygen. Operation.—Release. Result.—Well. Remarks.—Paralytic ileus; enterostomy; release adhesions; resection enterostomy; end-to-end anastomosis.

No. 18,963, male, aged thirty-eight years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Gradual, one day complete. General condition.—Poor. Anæsthesia.—Gas and oxygen. Operation.—Release. Result.—Well. Remarks.—Paralytic ileus; enterostomy; release adhesions; resection enterostomy; end-to-end anastomosis.

No. 22,508, male, aged thirty-nine years. Type of obstruction.—Volvulus about adhesions to laparotomy wound; appendicitis; peritonitis. Time since onset.—One to two days complete. General condition.—Fair. Anæsthesia.—Spinal; local. Operation.—

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Release; enterostomy. Result.—Well. Remarks.—Did not improve after release. Enterostomy then done.

No. 32,610, male, aged five years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Gradual; ten days post-operative. General condition.—Fair. Anæsthesia.—Spinal. Operation.—Release; enterostomy. Result.—Well. Remarks.—Enterostomy persisted as faecal fistula for long time. Then closed spontaneously.

No. 39,065, female, aged forty-four years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Gradual, eighty-four days post-operative; one to two days complete. General condition.—Fair. Anæsthesia.—Gas and oxygen. Operation.—Release; enterostomy. Result.—Well.

No. 39,823, male, aged twenty-two years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Gradual, ten days post-operative, one day complete. General condition.—Poor. Anæsthesia.—Local, gas and oxygen. Operation.—Enterostomy; release. Result.—Well. Remarks.—Two enterostomies; release adhesions; resection; enterostomy; end-to-end anastomosis; subphrenic abscess.

No. 41,539, male, aged forty-six years. Type of obstruction.—Adhesions, ruptured appendix, peritonitis. Time since onset.—Eight days post-operative; one to two days complete. General condition.—Poor. Anæsthesia.—Gas and oxygen; ether. Operation.—Release. Result.—Well. Remarks.—Enormous distention all way to Treitz's ligament.

No. 41,560, male, aged forty-five years. Type of obstruction.—Twist about adhesions to laparotomy wound. Bleeding gastric ulcer; open wound; secondary closure. Time since onset.—Ten days post-operative; three days complete. General condition.—Fair. Anæsthesia.—Avertin; gas and oxygen. Operation.—Release. Result.—Well.

No. 42,274, female, aged forty years. Type of obstruction.—Volvulus about adhesions to laparotomy wound. Acute cholecystitis; peritonitis. Time since onset.—Seven days post-operative; two to three days complete. General condition.—Fair. Anæsthesia.—Gas and oxygen. Operation.—Release. Result.—Well. Remarks.—Confusion with post-operative dilatation of stomach.

No. 43,356, female, aged thirty-five years. Type of obstruction.—Pelvic abscess; appendicitis; peritonitis local. Time since onset.—Seven days post-operative; one to two days complete. General condition.—Good. Anæsthesia.—Gas and oxygen. Operation.—Release. Result.—Well.

No. 52,263, female, aged twenty-five years. Type of obstruction.—Adhesions pelvis, appendicitis; local peritonitis. Time since onset.—Gradual, seven days post-operative; one day complete. General condition.—Good. Anæsthesia.—Spinal. Operation.—Release. Result.—Well.

No. 52,263, female, aged twenty-five years. Type of obstruction.—Volvulus about adhesions laparotomy wound. Time since onset.—Sudden; waited two days. General condition.—Poor. Anæsthesia.—Local, ether. Operation.—Release. Result.—Well. Remarks.—Patient critically ill after volvulus. Diagnosed as pulmonary embolism at first.

No. 52,506, male, aged seven years. Type of obstruction.—Adhesions, appendicitis; peritonitis. Time since onset.—Gradual, six days post-operative; one day complete. General condition.—Fair. Anæsthesia.—Drop ether. Operation.—Release. Result.—Well. Remarks.—Faecal fistula cæcum; spontaneous closure.

No. 34,716, male, aged forty-four years. Type of obstruction.—Adhesions, appendicitis; peritonitis. Time since onset.—Gradual; ten days post-operative; thirty-six hours complete. General condition.—Fair. Anæsthesia.—Spinal, drop ether. Operations.—Two enterostomies. Result.—Died. Remarks.—Subhepatic abscess; bronchopneumonia; unreleased adhesions at post-mortem.

No. 38,789, male, aged forty years. Type of obstruction.—Kink about adhesion, laparotomy wound. Ruptured gastric ulcer; pelvic abscess. Time since onset.—Gradual; ten days to two weeks; two to three days complete. General condition.—Poor. Anæ-

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thesia.—Avertin, local. Operation.—Enterostomy. Result.—Died. Remarks.—Hemolytic streptococcus peritonitis; obstruction diagnosed too late.

No. 42,311, male, aged twelve years. Type of obstruction.—Multiple obstructions; adhesions, appendicitis; peritonitis. Time since onset.—Gradual, two and one-half weeks post-operative; complete obstruction one to two days. General condition.—Poor. Anæsthesia.—Gas and oxygen. Operation.—Repeated operations. Result.—Died. Remarks.—Appendectomy; two weeks post-operative, drainage pelvic abscess; eighteen days post-operative, release obstruction; enterostomy; thirty-two days post-operative, release obstruction; thirty-four days post-operative, lateral anastomosis ileum to colon; forty-eight days post-operative, closure ileocolic fistula; fifty-one days post-operative, same; seventy-seven days post-operative, release multiple adhesions pelvis; resection enterostomy; end-to-end anastomosis. Boy almost moribund. Bad case. Too much surgery at close.

No. 45,605, male, aged forty-seven years. Type of obstruction.—Volvolus about adhesions laparotomy wound. Acute cholecystitis; peritonitis. Time since onset.—Gradual; seven days post-operative; complete two days. General condition.—Poor. Anæsthesia.—Gas and oxygen; ether. Operation.—Release. Result.—Died. Remarks.—Paralytic ileus at autopsy.

No. 51,868, female, aged two years, eleven months. Type of obstruction.—Adhesions, appendicitis; peritonitis. Time since onset.—Gradual, fourteen days; one to two days complete. General condition.—Poor. Anæsthesia.—Drop ether. Operation.—Enterostomy only. Result.—Died. Remarks.—Unreleased adhesions at post-mortem.

### Miscellaneous

No. 260, male, aged twenty-eight years. Type of obstruction.—Mesenteric thrombosis. Time since onset.—Five days. General condition.—Peritonitis; ruptured appendix. Anæsthesia.—Local, gas and oxygen. Operation.—Enterostomy. Result.—Well. Remarks.—Bowel Concord grape color. Cannot account for recovery.

No. 18,754, male, aged four years. Type of obstruction.—Intussusception. Time since onset.—Eight hours. General condition.—Fair. Anæsthesia.—Gas and oxygen. Operation.—Reduction. Result.—Well.

No. 25,964, male, aged seven months. Type of obstruction.—Intussusception. Time since onset.—Eight hours, possibly thirty-two. General condition.—Poor. Anæsthesia.—Drop ether. Operation.—Reduction; lateral anastomosis. Result.—Well.

No. 27,833, female, aged six months. Type of obstruction.—Intussusception. Time since onset.—Twelve hours. General condition.—Good. Anæsthesia.—Drop ether. Operation.—Reduction. Result.—Well.

No. 3335, male, aged twenty-five years. Type of obstruction.—Through tear in mesentery. Time since onset.—Nine hours. General condition.—Good; non-protein nitrogen, 66. Anæsthesia.—Local, gas and oxygen. Operation.—Lateral anastomosis; enterostomy. Result.—Well. Remarks.—Resection involved loop several months later.

No. 23,505, male, aged thirty-three years. Type of obstruction.—Through tear in mesentery. Time since onset.—Eleven days.—General condition.—Poor. Anæsthesia.—Ether. Operation.—Release, enterostomy. Result.—Died. Remarks.—Peritonitis present. Too late for surgery.

No. 27,172, male, aged thirty-eight years. Type of obstruction.—Through tear in mesentery. Time since onset.—Two days. General condition.—Poor. Anæsthesia.—Gas and oxygen; ether. Operation.—Release, stripping of bowel; enterostomy. Result.—Died. Remarks.—Late case. Wisdom of surgery questionable.

No. 44,626, male, aged forty-one years. Type of obstruction.—Complete obstruction at terminal ileum; cancer of cæcum. Time since onset.—Two days. General condition.—Fair; non-protein nitrogen, 46. Anæsthesia.—Ether. Operation.—Ileocolostomy. Result.—Well. Remarks.—Resection cancer ascending colon later.

No. 42,674, female, aged forty-four years. Type of obstruction.—Gall-stone obstruc-

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tion. Time since onset.—Five days. General condition.—Poor. Anæsthesia.—Ether. Operation.—Removal of stones; gastroenterostomy. Result.—Died. Remarks.—Late case. Too much surgery.

### COMPLETE SERIES

Simple obstruction, seven cases, two deaths, 28.5 per cent.; strangulation complete, twenty-two cases, eleven deaths, 50 per cent.; strangulation partial, two cases, no deaths; combined obstruction and strangulation, seventy-four cases, seventeen deaths, 22.9 per cent. Total, 105 cases, thirty deaths, 28.5 per cent.

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## LYMPHOSARCOMA OF THE SMALL AND LARGE INTESTINES

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A SEARCH of the literature on the subject of lymphosarcoma of the intestines reveals a marked diversity of opinion concerning its morphology, histogenesis and etiology. This state of affairs is further complicated by the lack of any uniform nomenclature. As Ewing pointed out, there has prevailed for many years an inadequate clinical classification of lymphoid tumors, *viz.*:

- (1) Inflammatory hyperplasia—simple tumors, response of lymphoid tissue to bacterial or toxic irritants.
- (2) Neoplastic tumors—uncommon tumors; atypical growths; unknown etiology.
- (3) Intermediary types—uncommon tumors; diffuse enlargements; unknown etiology.

Recognizing the deficiencies of such a classification, Ewing has classified lymphoid tumors from the standpoint of histogenesis and structure. The cellular elements of lymphoid tissue that may give rise to tumors are (1) lymphocytes, (2) reticulum cells of the follicles and pulp, and (3) endothelial cells of the pulp and cavernous sinuses.

<i>Origin</i>	<i>Anatomical Types</i>	<i>Clinical Types</i>
Lymphocyte	Lymphocytoma	Simple lymphoma, tuberculous lymphoma, lymphatic leukemia, pseudoleukemia, malignant lymphocytoma (lymphosarcoma)
Reticulum cells	Large round-cell, hyperplasia, or neoplasia	Granuloma malignum, myeloid leukemia, Hodgkin's sarcoma, large-cell sarcoma (lymphosarcoma)
Endothelial cells	Endothelial hyperplasia or neoplasia	Endothelial hyperplasia of tuberculosis, <i>etc.</i> , endothelioma

Thus there are two types of lymphosarcoma which may arise from lymphoid tissue: (1) Malignant lymphocytoma; (2) reticulum-cell sarcoma (large round-cell lymphosarcoma). In many instances, the two histological types appear to maintain their identity and are associated with different clinical conditions and different etiological factors. But, despite the fact that the individuality of the two types has been established, they are still considered under one heading because of the indefinite relation of the lymphocyte to the reticulum cell.

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Kundrat was the first to isolate lymphosarcoma from the group of closely allied diseases of the lymphatics, all of which were included under the term pseudoleukemia or lymphosarcoma, and also described the clinical characteristics. He showed that the origin of this tumor was in the lymph-nodes or adenoid tissue elsewhere in the body. He pointed out that systemic effects were rarely noted in lymphosarcoma in contradistinction to what is found in leukemia and pseudoleukemia.

Ewing states that the structure of lymphosarcoma is somewhat specific. The tumor presents a diffuse growth of lymphoid cells which tends to obliterate the structure of the affected node or follicle. The individual cells may vary in size, being small, of medium size, or large. Occasionally, large multinucleated cells are seen, but giant cells only rarely. The stroma of the tumor shows no regular form but is more likely to be of irregular distribution. In some areas, the reticulum is deficient; in others, it is diffuse with a tendency to fibrosis. Regressive changes are seldom seen, but the occlusion of blood-vessels, especially in bulky growths, may occur and lead to ulceration.

In the same cases of lymphosarcoma, there may be found among the lymphoid cells such cellular elements as plasma cells, eosinophiles and lymphocytes whose presence signify an infectious process and tend to obscure the diagnosis of lymphosarcoma.

*Terminology.*—Lymphosarcoma of the intestines has been written about under various names. It is most frequently reported as "sarcoma" of either the small or large round-cell type. The tumor has also been reported as lymphocytoma, lymphoblastoma, intestinal Hodgkin's disease, chronic inflammatory tumor, lymphoid granulation tumor and granulomatous pseudoleukemia. These names are frequently used interchangeably. Graves has strongly advocated the use of the term "lymphoblastoma," which, according to Mallory and Ribbert, is a tumor of mesenchymal origin and the cells of which tend to differentiate into cells of the lymphocyte series. He points out that "sarcoma" should be applied only to tumors of mesenchymal origin with cells which tend to differentiate like fibrous or mucous connective tissue, muscle, bone, or cartilage cells. Minot and Isaacs suggest the use of the terms "lymphoblastoma" or "malignant lymphoma" to include all types of malignant lymphoid tumors, such as lymphatic leukemia, pseudoleukemia or aleukemic lymphatic leukemia, Hodgkin's disease and lymphosarcoma.

Webster believes that lymphosarcoma, lymphatic leukemia and leukosarcoma are different manifestations of the same disease which he proposes to call lymphadenosis, leukemic or aleukemic. He believes that it represents a neoplasm that is formed as a direct response on the part of the lymphocytes to a chemotactic influence exerted by the disease-causing agent. He believes that a localized lymphosarcoma may, under certain conditions, become generalized and with a blood picture of lymphatic leukemia, may terminate as a leukosarcoma.

However, for the want of a better name, for the present we shall adhere to the term "lymphosarcoma," at least until the histogenetical and morphologi-

cal characteristics and relationships of the structural components of these tumors are more clearly established.

Marked differences of opinion exist in regard to the clinical picture presented by this tumor and the appropriate treatment. However, since no one surgeon or clinic has had a series of cases sufficiently large to warrant definite clinical conclusions, it may not be out of place to quote extensively the opinions of the various contributors to this subject. Our own opinion and conclusions are based on a comprehensive statistical study of 126 cases.

*Incidence.*—After an extensive review of the literature, we feel that a complete and accurate compilation of the cases of primary lymphosarcoma of the intestines is well-nigh impossible for several reasons:

- (1) Owing to the marked variation and interchangeability in the terminology accorded to these tumors, the majority of the cases of true lymphosarcoma of the intestines have been reported as other types of tumors. The condition is most frequently reported as "sarcoma," and often the correct diagnosis and proper classification were made only after careful study of the pathological data in the cases reported.
- (2) In many cases, the pathological report was absent or incomplete, and often other data (regarding age, sex, site of tumor, duration, *etc.*) were insufficient to supply a definite diagnosis.
- (3) One of the greatest difficulties encountered in the tabulation of the cases is the checking up and tracing of incomplete or incorrect references.

However, our task has been considerably lightened by the excellent articles by Crowther and Graves. In 1913, Crowther collected 191 cases of "sarcoma" of the small intestine. In this series, there were 119 cases of the lymphosarcoma type, to which the author added three cases. Graves reviewed the literature up to June, 1919, and reported a total of 249 cases, including three cases of his own. We have collected 125 additional cases and add one case of our own, making a total of 375 cases. In our series, there are included eight cases diagnosed at autopsy—Staemmler (two cases), Molson, Ablon, Clopton, Hulbert, Zimmer and Bensaude, Cain and Horwitz.

An idea of the difficulties encountered in the proper classification of "sarcomatous" tumors of the small intestines can be gathered from a review of Crowther's findings. In his series of 191 cases, he found small round-cell sarcoma, 68; lymphosarcoma, 48; spindle-cell sarcoma, 22; myosarcoma, 7; melan sarcoma, 5; fibrosarcoma, 4; large round-cell sarcoma, 3; myxosarcoma, 3; endothelial-cell sarcoma, 3; polyform-celled sarcoma, 2; mixed-cell sarcoma, 2; fibromyxoma, 2; osteosarcoma, 1; and 21 undifferentiated tumors which were reported simply as "sarcoma." From this list, as noted by Graves, one can obtain 119 cases of lymphosarcoma or lymphoblastoma, which include the cases of small round-cell sarcoma, large round-cell sarcoma and lymphosarcoma.

From the 126 cases collected by the present authors, we have the following pathological diagnoses: Lymphosarcoma, 82; lymphoblastoma, 2; lymphocytoma, 1; round-cell sarcoma, 17; small round-cell sarcoma, 7; large round-cell sarcoma, 3; lymphosarcoma or round-cell sarcoma, 1; sarcoma with infiltrating eosinophils, 1; small round-cell sarcoma of lymphoid type, 1; lymphoid sarcoma with acute malignant lymphogranulomatosis, 1; large round-cell sarcoma of endothelial type, 1; round-cell embryonic fibroma, 1; chronic inflammatory tumor, 4; chronic inflammatory tumor or sarcoma, 3; and chronic inflammatory tumor or large round-cell sarcoma, 1.

The relative rarity of lymphosarcoma of the intestines is borne out by the observations of the early contributors whose studies were based on "primary sarcoma." Libman

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states that not a single case of primary sarcoma of the intestines was observed in the Berlin Pathological Institute from 1859 to 1875. Nothnagel reported only nine cases of sarcoma in 21,358 autopsies in the General Hospital of Vienna from 1882 to 1893. Smoler found only thirteen cases of primary sarcoma of the small intestines in 13,036 autopsies between the years 1883 and 1898 at the Prague Pathological Institute.

Nothnagel's figures are interesting in this respect. He found 243 cases of carcinoma of the intestines in 2,125 autopsies on carcinoma cases and three cases of sarcoma of the intestines in 274 autopsies on sarcoma cases. Mueller reported 521 cases of carcinoma with forty-one of the intestinal type and 102 cases sarcoma with one of the intestinal type. Warthin reported only two cases of lymphosarcoma of the small intestines in an analysis of 2,000 malignant neoplasms in young people between one and thirty years of age examined in the Pathological Department of the University of Michigan. Staemmler found thirty-three cases of sarcoma of the intestines in an analysis of 54,000 autopsy protocols obtained from the combined records of German and Austrian hospitals.

W. Fisher reviewed the records of the Royal Prince Alfred Hospital in Sydney, Australia, from 1910 to 1925, and found five cases of sarcoma in a series of 265 cases of



FIG. 1.



FIG. 2.

FIG. 1.—A section taken from the edge of the tumor, demonstrating the diffuse nature of the growth. The tumor, arising in the submucosa, has invaded and destroyed the muscularis. The mucosa is elevated and fairly well preserved in this region, but in one portion is invaded by tumor cells. (x 5.)

FIG. 2.—Sections taken from the central portion of the tumor mass, showing marked invasion and destruction of all the intestinal layers. The involvement of the mucosa varies from slight compression and distortion to complete degeneration and necrosis. (x 5.)

malignant disease of the large and small intestines, excluding the rectum. Among 182 cases of malignant disease of the rectum and anus, there were no cases of sarcoma. Sarcoma of the stomach was not included in this review. Loria studied the records of the Charity Hospital of New Orleans from 1914 to 1923, inclusive, and found forty-four cases of intestinal carcinoma among 1,817 carcinomas (excluding gynecological carcinomas) and seven cases of intestinal sarcoma among 431 cases of sarcoma.

Vercellotti found seven cases of sarcoma of the intestines in 14,585 autopsies (.4 per cent.) and in 1,345 cases of malignant tumors of the entire body (0.53 per cent.). Of the 114 cases of malignant tumors of the intestines, seven were sarcomas (6.14 per cent.) and 107 were carcinomas. In a study of twenty-three cases of tumor of the small intestines, Puccinelli found lymphosarcoma, seven cases; carcinoma, seven cases; and sarcoma, two cases. The largest series of lymphosarcoma of the intestines collected in one clinic in this country is reported by Rankin and Chumley from The Mayo Clinic and comprises eighteen cases of lymphosarcoma of the large bowel.

In an earlier paper, Bull stated that the relation of these tumors is about one sarcoma to twenty carcinomas. He pointed out that sarcoma may be found in the small or large intestine or rectum, whereas carcinoma is more frequent in the large intestine. Rankin stated that while lymphosarcoma of the small intestine is of relatively infrequent occurrence as compared with carcinoma of the entire intestinal canal, it is perhaps found as frequently in the small bowel as any form of malignancy.

Staemmler reports the incidence of sarcoma of the intestine at autopsy as 0.06 per cent. and carcinoma of the intestines at autopsy as 1 per cent. He concludes that the proportion of sarcoma to carcinoma of the intestine, as established at the post-mortem table, is about one sarcoma to sixteen carcinomas, while in surgical practice (biopsies), based on statistics of German and Austrian surgeons, it is about one sarcoma to 100 carcinomas.

Lymphosarcoma is more frequent in the small intestine than in the large intestine, not excluding the rectum. This fact is attested by a review of our own and of other statistics.

The anatomical location of the tumor in the 126 cases collected by the authors is as follows: Duodenum, 4; duodenum and stomach, 1; duodenum and jejunum, 1; jejunum, 17; jejunum and ileum, 4; ileum, 36; ileocecal portion 8; "small intestines," 15; "small intestines" and stomach, 1; appendix, 2; appendix and cæcum, 1; cæcum, 17; ascending colon, 2; transverse colon, 1; descending colon, 2; sigmoid, 4; rectum, 8; rectum and sigmoid, 1; ascending colon, cæcum, ileum, and jejunum, 1; descending colon, sigmoid, and jejunum, 1; and "intestines," 1. Further analysis of these figures shows that the small intestine was the site of the tumor in seventy-seven cases, the large intestine (including the cæcum) in thirty-two cases, and ileocecal region in eight cases. The most common location for the tumor was the ileum (thirty-six cases) and next in order, the jejunum and cæcum (seventeen cases each). These findings are in accord with the general belief that lymphosarcoma is found more frequently in the small than in the large intestine, and that the ileum is involved more often than any other portion of the intestinal tract.

In his series of 191 cases of sarcoma of the intestines, Crowther found the exact location mentioned in 129 cases, and these included: Duodenum, 12; duodenum and jejunum, 7; jejunum, 32; jejunum and ileum, 8; ileum (chiefly in terminal portion), 55; cæcum, 8; diffused throughout the intestine, 8. In Comer and Fairbanks series of 175 cases of "sarcoma" of the alimentary tract, the site was noted as follows: Oesophagus, 14; stomach, 58; ileocecal region, 20; colon, 11; rectum, 7. Goldstein has recently collected 592 cases of primary sarcoma in the alimentary tract and found the location mentioned: In the oesophagus, 21; stomach, 265; large and small intestine, 130; appendix, 17; liver, 59; gall-bladder, 16; pancreas, 19; tongue, 65. Staemmler collected 400 cases of sarcoma of the intestinal tract, which included ten personal observations from the laboratory of the Chemnitz Pathological Institute. The site of the lesion was recorded in 394 cases and included the duodenum, 34; jejunum, 44; ileum, 79; small intestines, 61; cæcum and ileocecal coil, 45; appendix, 12; colon, 16; sigmoid, 4; rectum, 91; large intestine, 8.

Friend collected nineteen cases of lymphosarcoma of the appendix. He also reported one case of his own, and to this series may be added the case reported by Hagyard. Liu reported twelve cases: Ileum, 9; cæcum, 2; and sigmoid, 1.

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In Weeden's series of thirteen cases of lymphosarcoma of the gastro-intestinal tract, the location of the tumor was found to be in the small intestine, 10; large intestine, 2; and stomach, 1. In the series of eighteen cases of lymphosarcoma of the large intestines reported by Rankin and Chumley, the site of the lesion was in the cæcum, 13; descending colon, 1; sigmoid, 1; rectum, 3. Vercellotti also noted that sarcoma was found more frequently in the small than in the large intestine. The site of the lesion in his seven cases was: Duodenum, 2; small intestine, 3; cæcum, 1; rectum, 1.

From an analysis of the above statistics, it is evident that lymphosarcoma may be found in any portion of the intestinal tract, but that the ileum is the most common site for this tumor. However, it is interesting to note that Libman found the duodenum to be as common a site as the ileum. His series of fifty-nine cases of primary sarcoma of the small intestines included the following: In the duodenum, 15; jejunum and ileum, 18; ileum, 14; entire intestinal tract, 3.

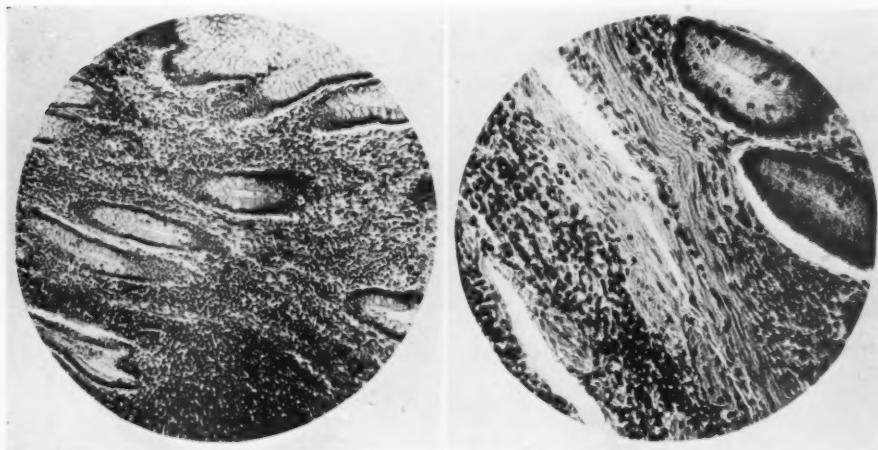


FIG. 3.

FIG. 4.

FIG. 3.—Invasion of the mucosa by tumor-cells was noted in practically all sections of the tumor. This section was taken from the edge of the tumor mass. (x 150.)

FIG. 4.—Photomicrograph showing the diffuse infiltration of the mucosa, submucosa, and muscularis, by the tumor. (x 150.)

*Age.*—Lymphosarcoma of the intestines may occur at any age, but is most frequently found in the first, third, and fourth decades, as noted in the tables compiled by Graves, Crowther, and the authors. Rankin states that the age of the individual should have some significance in the diagnosis of lymphosarcoma, which he considers a disease associated with early childhood or young adult life. Lymphosarcoma of the intestines has also been known to occur in elderly people. Weeden reported a case in a female, eighty-four years old.

The frequency of the tumor in childhood is striking. Five of the twelve cases reported by Liu occurred in the first decade. Successful operations for this condition in children five to six years of age have been reported by Power, Barling, and Zwahlenburg. Goodman reported a case of lymphosarcoma of the sigmoid in a child of four years. In a case reported by Stern,

the tumor was present at birth and caused intestinal obstruction from which the patient died.

In Libman's series of fifty-nine cases of "sarcoma" of the small intestines, more than 50 per cent. had occurred between the ages of twenty and forty years. The youngest patient was five days old and the oldest twenty years. In the series of eighteen cases of lymphosarcoma of the large intestines reported by Rankin and Chumley, the youngest patient was eleven years and oldest seventy years. Three of the patients were less than thirty years old, and all of these cases occurred in the second decade. The average age incidence was 45.4 years.

The figures for age incidence in our series (excluding the series reported by Rankin and Chumley) are given below. The average age for the 106 cases reported is 33.19 years, which is decidedly lower than that reported by Rankin and Chumley.

AGE INCIDENCE					
<i>Crowther's Series</i>		<i>Graves' Series</i>		<i>Our Series</i>	
Years	Cases	Years	Cases	Years	Cases
1-10	24	1-5	13	1-5	7
		6-10	11	6-10	11
10-20	12	11-15	2	11-15	5
20-30	36	16-20	6	16-20	5
30-40	32	21-25	8	21-25	6
		26-30	9	26-30	9
40-50	32	31-35	12	31-35	19
50-60	17	36-40	9	36-40	13
60-70	4	41-45	5	41-45	2
		46-50	3	46-50	6
70-80	2	51-55	3	51-55	3
		56-60	2	56-60	8
		61-65	1	61-65	6
		66-70	1	66-70	4
				71-75	1
				76-80	0
				81-85	1

*Sex and Race.*—All writers upon the subject agree that males show a greater predisposition to the disease than females. According to Speese, Liu, and Weeden, sarcoma of the intestines occurs in males more frequently than in females, in the ratio of two to one. Rankin stated that the sex incidence is equal as regard lymphosarcoma of the small intestine. Graves states that males were affected about three times as often as females. Rankin

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and Chumley, in their series of eighteen cases of lymphosarcoma of the large bowel, noted thirteen males and five females. Our studies on the sex incidence are in accord with Graves', inasmuch as in our series there were ninety males and thirty-six females.

Lymphosarcoma of the intestines affects the Negro as well as white people. Liu states that the ratio is four whites to one Negro. This appears to be a rather high percentage and in a large series the proportion of involvement in the Negro is undoubtedly much smaller. In our study, there were forty-three white, three black (Liu's cases). In eighty-three cases the race was not mentioned, but presumably the patients were of the white race.

*Etiology.*—The causative factors in the production of lymphosarcoma of the intestines have not been clearly established. Trauma is mentioned in some of the reported cases and may be of some etiological importance. It is a strange coincidence that the tumor occurs much oftener in people of the working class. Single traumatic insults have long been considered of importance in the development of sarcoma in general, as evidenced by the numerous cases reported by Coley, Lowenstein, and others. Zwalenburg reported a case of a tumor of the small intestine in a five-year-old boy that developed at the site of the injury six weeks after an abdominal trauma. Peterson, in his series of eighty-five cases, found three in which the tumor occurred six to ten weeks after a severe contusion of the region involved.

In the case reported by Coley, the patient gave a history of striking the abdomen with the elbow after falling eighteen feet. The accident had occurred six or seven months before he consulted the physician. Loria's patient sustained an injury to the left half of the abdomen as a result of being struck by a wheelbarrow. The accident occurred three months prior to consultation and operation. Simoncelli's patient received an injury to his left flank which resulted in severe abdominal pain and other symptoms of intestinal obstruction. At operation, at this time, a lymphosarcoma of the jejunum was found.

The German writers consider direct traumatism, bowel injuries from falls, blows and contusions, as the most frequent etiological factor in the development of lymphosarcoma of the intestines. In the development of carcinoma of the intestinal tract, they stress the etiological rôle of chronic irritation, inasmuch as carcinoma occurs most often at the friction points in the intestinal canal, *i.e.*, at the cardia, pylorus, ileocecal valves, flexures of the colon, rectum and anus. Vercellotti stated that traumatic factors are most important in the development of sarcoma of the intestines, more so than in carcinoma.

The association of tuberculosis and lymphosarcoma elsewhere in the body has been observed, but is regarded as an accidental association, despite the fact that the tubercle bacillus has been found in lymphosarcomatous growths and that occasionally lymphosarcoma may strongly resemble or be indistinguishable from certain infectious granulomas occurring in the gastro-

intestinal tract, such as a hypoplastic tuberculosis. According to Mikulicz, a combination of tuberculosis and sarcoma, especially of lymphosarcoma, is not unusual.

Nothnagel has reported a case of lymphosarcoma of the small intestines developing in the base of an old tuberculous ulcer. Schmidt (1898) reported a case of lymphosarcomatosis of the jejunum associated with tuberculosis of the lymphatic glands and a tuberculous infection of the right lung. The latter author states that, although there is no connection between the tuberculosis and lymphosarcoma, they might possibly possess a common source in the sense of a "hereditary constitutional anomaly." One of the patients in the series reported by Rankin and Chumley had a healed pulmonary tuberculosis. Two of Puccinelli's patients had a pleuritis suggesting tuberculosis, despite the fact that the sputum of one was negative. Friend noted tubercles in the appendix and also in the omentum, at the time of operation. Wortman found tuberculosis of the mesenteric nodes in one of his cases of intestinal lymphosarcoma.



FIG. 5.—Photomicrograph illustrating the origin of the tumor in the submucosa from one of the Peyer's patches. Normal mucosa is seen above the tumor tissue. No germinal centres are noted in the lymphoid zone. (x 600.)

The relation of tuberculosis to malignant disease, more particularly to carcinoma than to sarcoma, has been studied by Broders at The Mayo Clinic. He reported that in twenty cases of tuberculosis and malignant disease, the two conditions occurred in the same organ or tissue eight times (40 per cent.); in seven cases (35 per cent.) the two conditions were actually associated in the same microscopical field.

Opinions vary as to the etiological relationship of syphilis to lymphosarcoma. Schmidt states that an antecedent history of syphilis in lymphosarcoma cases is not common. Von Esmarch found that more than one-half of the patients with various types of sarcoma had syphilis. In cases reported by Douglas, Koch, Guliani, and Hulbert, there was a history of syphilis. Berghausen has reported two cases of generalized lymphosarcomatosis in syphilitic patients.

In the authors' review of the literature, several cases presented an interesting history of antecedent or intercurrent disease, the etiological relationship of which is not quite clear. Cases of intestinal lymphosarcoma occurring years after typhoid fever have been reported by Cabot, Rankin, and

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Graham. One of the patients in Rankin and Chumley's series of lymphosarcoma of the large intestine (also reported by Bargen) gave a history of chronic ulcerative colitis antedating the development of the malignant tumor. In one of the cases reported by W. Fisher, a man, sixty years old, had been addicted to eating white sand; the other patient, a woman sixty-seven years, had had six pregnancies. Hulbert's patient was treated for severe alcoholism in addition to syphilis. Generalized icterus with hepatic and splenic enlargement due to stricture of the common duct and obliteration of the pancreatic ducts was present in Ablon's patient and evidently had no etiological bearing on the associated intestinal tumor.

Previous operations had been performed in several cases. Firth noted the development of a lymphosarcoma five months after operation for a strangulated hernia. One of Gerster's patients was likewise operated upon for a right incarcerated hernia, but the pain persisted and a second operation disclosed a lymphosarcoma of the jejunum. In Graham's case, an operation for intussusception had been performed six weeks before an operation for a tumor at the ileocecal valve. Appendectomies had been performed in the cases reported by Simoncelli, Beer, and Weeden.

Certain writers, particularly De Noyelles and Webster, believe that the lymphoid cells proliferate wildly in the presence of some irritation, chemical or bacterial in nature. De Noyelles stresses the importance of chronic irritation or a specific toxin in the development of these tumors. He points out the histological resemblance of lymphosarcoma to an infectious granuloma and suggests that lymphosarcoma may be but a bizarre or later form of Hodgkin's disease or lymphoblastic or lymphocytic leukemia. Bunting and Huston have shown that the lymphocytes in the blood-stream migrate into the intestinal mucosa to function normally. It is conceivable that these lymphocytes may assume a perverted function and grow wildly in the presence of some abnormal irritant.

*Symptomatology.*—There is no clinical picture absolutely characteristic of this disease. The condition may be insidious in onset or may be ushered in as an acute abdominal catastrophe. The type and character of the symptoms are varied and appear to be more or less dependent upon the duration of the growth and the degree of intestinal obstruction caused by it. In the analysis of the cases in our series, we found fifteen cases of acute intestinal obstruction, eleven of chronic obstruction, four of acute obstruction superimposed upon a chronic type, but in the remainder, information relative to the occurrence and type of obstruction was meagre or absent.

The duration of the illness was mentioned in seventy-five cases. In several cases, the symptoms were acute (less than twenty-four hours) and necessitated immediate operation. In the majority of the cases, symptoms had been present over a longer period of time, varying from one day to ten years. The various time intervals for the duration of symptoms in the above series is indicated in the following table:

1 to 24 hours.....	2 cases	6 to 12 months.....	5 cases
1 to 7 days.....	4 cases	1 to 2 years.....	10 cases
1 to 4 weeks.....	10 cases	2 to 5 years.....	7 cases
1 to 6 months.....	34 cases	5 to 10 years.....	3 cases

The average duration of the illness was 258 days, or 8.6 months.

When the tumor completely occludes the lumen of the intestine as a result of intussusception, adhesions or invasion of the intestinal wall by the growth, symptoms of abdominal ileus may ensue. If the obstruction of the intestines is only partial, the patient may show the symptoms of a chronic intermittent intestinal obstruction. It should be borne in mind that intussusception secondary to tumor formation is seldom accompanied by the usual symptoms associated with intussusception in children. Occasionally there is an absence of severe abdominal pain, vomiting and bloody or mucous stools in adults despite invaginations. The absence of these latter symptoms in adults is most likely due to the fact that complete obstruction is rather uncommon but instead there occurs a dilatation of the infiltrated wall. In cases with partial stenosis of the intestinal lumen, the patient readily adjusts himself to narrowed intestinal passage.

Abdominal pain occurs practically in every case. It was present in seventy-nine cases in our series and not mentioned in the remaining cases. As a rule, the pain is constant, and is confined to the part of the abdomen where the tumor is situated, but it may be more or less generalized over the entire abdomen when an acute obstruction is present, and localized in a chronic obstruction. The pain is of an indefinite nature and frequently colicky in character but is not affected by eating. Ochsner points out that the indefinite abdominal pain accompanying this disease is persistent and differs from the pain in the common chronic abdominal infection in that it is not relieved by rest and starvation.

There is always some bowel disturbance associated with this disease. Bowel movements are frequently irregular, as indicated by the thirty-six cases noted with constipation as a prominent symptom. The stools may occasionally contain blood, as happened in eighteen of our cases, or mucus. Constipation alternating with diarrhea was present in twenty-three cases. This latter symptom complex and the less frequent occurrence of intestinal haemorrhage offers two distinctive findings that are more or less characteristic of lymphosarcoma of the intestines. The alternating constipation and diarrhoea is due to the accumulation and stagnation of the fecal contents in dilated and paralyzed pouches which are incapable of peristalsis until the toxic contents of the dilated portion cause contractions of the bowel wall above it and force the contents out through the gut below, so that there results a fetid diarrhea. Repeated attacks of obstinate constipation may occasionally be noted, but constipation is not common unless there is acute obstruction due to kinking of intestines or to intussusception. Tenesmus is a rather common symptom.

The patients are usually thin, anaemic, and cachetic, especially those with

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a tumor of long duration. However, in some cases, the patient may appear as a healthy, robust individual who had developed an acute abdominal infection. There may be a loss of appetite with gradual loss of strength. Nausea and vomiting are commonly present, although they were noted in but six and twenty-five cases, respectively. Hematemesis occurred in only one case (Cabot's). Changes in temperature and pulse are noted as the degree of obstruction increases. In a case reported by Booth, the temperature chart simulated that of typhoid fever. In sixteen cases, elevations of temperature are recorded.

The abdominal findings are not constant. Tenderness, diffuse or localized, is usually present, but is definitely mentioned in only eighteen cases. A tumor mass may be found in various parts of the abdomen, but is noted most frequently in lower quadrants. An abdominal tumor mass was present in fifty-eight cases, absent in eleven cases and not mentioned in the remainder.

The tumors may vary considerably in size; usually they are as large as a hen's egg, or a fist, but they may attain the size of an adult's head. In several cases, the presence of a large tumor mass was detected by the patient. The presence of a sausage-shaped tumor together with symptoms of chronic intestinal obstruction may be considered distinctive of the intussusception accompanying this disease. In an early case on palpation, the tumor is freely movable and the surface is smooth, though often somewhat irregular. In the later cases, the primary growth is palpated with extreme difficulty owing to the presence of numerous metastatic nodules. The presence of abdominal distention resulting from the accompanying intestinal obstruction interferes with palpation, especially in the late cases. Ewald and Kasemeyer made a correct diagnosis of this disease on the basis of such a palpable tumor. Occasionally, the pressure of the tumor on the large vessels of the abdomen may produce ascites, edema of the legs, or distention of the veins of the abdominal and thoracic walls. In rare instances, the tumor mass has been noted to encroach upon the liver, biliary vessels and ducts and to produce jaundice. Disturbances in urination such as dysuria, frequency, and diminution of output of urine may result from the interference by the tumor mass with proper kidney and bladder function.

*Gross Pathology.*—Lymphosarcoma of the intestines may appear as an annular or polypoid growth, or both types may be present in the same individual. The annular type is more common than the polypoid. In our series, the former type was noted in thirty-two cases, the latter in twenty-six cases; the type was not mentioned in sixty-eight cases. The annular type is usually a single growth, whereas the polypoid may be multiple. On the other hand, the annular type may be very large and extensive and involve more than one loop of gut. The latter type of tumor has sometimes been termed the diffuse type of intestinal lymphosarcoma, and made up thirteen of the cases in our series. Of the twenty-six polypoid cases, fourteen were single and twelve multiple. In the polypoid type, the multiple growths appear as more or less localized outgrowths projecting from the intestinal wall

into the lumen. They usually vary in size from that of a pea to that of a walnut, but may be even larger. The small tumors have a fungoid appearance on the surface.

In forty-six cases of Lecene, the growth was single in thirty instances and multiple in sixteen cases. Liu noted that 60 per cent. of his cases were of the annular type, 33 per cent. polypoid, and in one case, there was an annular tumor at the ileocecal valve and a polypoid growth in the ascending colon. In 75 per cent. of Liu's series, the tumor was single; two patients had two tumors each, and one had ten separate growths.

Lymphosarcoma of the intestine usually begins in the lymphoid follicles, which are found in the submucosa, especially of the small intestine. In the

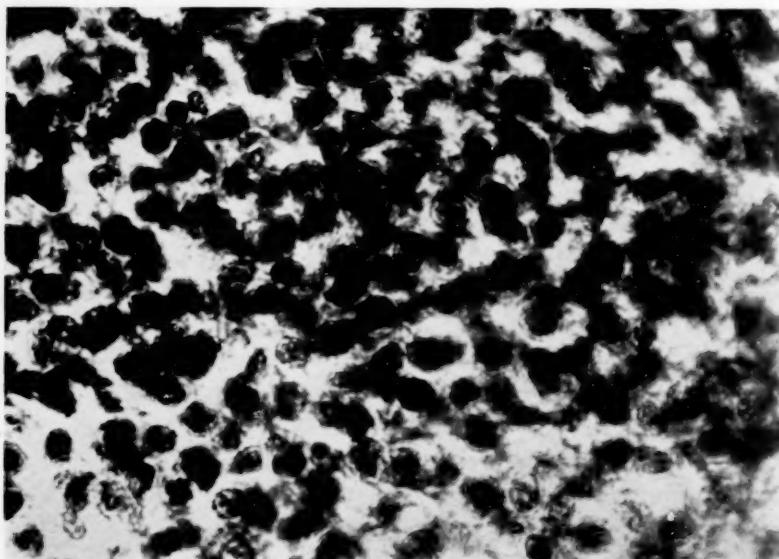


FIG. 6.—Cellular components of this tumor are predominantly large round-cell lymphocytes with an occasional small round-cell. The large round-cells appear to contain a liberal amount of clear cytoplasm, and, in many instances, appear to be multinucleated. The stroma is made up of fine, reticulated connective tissue. In this and other sections, there were relatively few blood-vessels noted, and these showed no evidence of endothelial hyperplasia or occlusion by tumor tissue. No germinal centres or Dorothy Reed cells were seen. (x 600.)

early stages, a localized thickening of the lymphoid follicle is noted which may or may not be accompanied by ulceration of the overlying mucous membrane. The tumor gradually invades the other intestinal coats, but rarely penetrates the serosal layer of peritoneum. Perforation of the intestine by the growth with a resultant peritonitis may occur, as noted in two cases in our series (Hulbert and Pissarewa). A generalized peritonitis was present in Loria's patient.

The tumor spreads laterally through the submucosa and gradually invades and destroys the muscular coats to appear as a subserous tumor. The surface of the tumor is not smooth but of an irregular contour, often studded with pebble or pea-sized nodules. As the tumor grows, ulceration of the

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mucous membrane occurs and gradually extends into the tumor mass, causing a certain amount of destruction and excavation. The tumor has a rather firm consistency.

There is a decided tendency to aneurismal dilatation of the lumen of the involved gut in most of the cases. This phenomenon occurred in eighteen cases in our series but is decidedly more common than these figures would indicate. The explanation of this phenomenon, as offered by Graves, is that the dilatation is due either to an early destruction of muscle fibres, with subsequent dilatation resulting from the accumulation of faeces, or to an early involvement of the submucous layer by the tumor which affects the plexus of nerves found in this layer. Frequently, there is an accompanying dilatation of the bowel proximal to the tumor which is due to a paralysis of the musculature by the invading growth.

Stenosis of the involved intestinal loop by the tumor is said by most writers to be less common than dilatation; however, in our series, there were thirty-seven cases with stenosis and only eighteen cases with dilatation. This disagreement between our figures and the accepted belief may be due to lack of complete pathological data in many of the cases. It does appear that dilatation of the intestinal lumen is more common than our figures would lead one to believe. Crowther found stenosis in only twenty-two of 191 cases of sarcoma of the intestine. Speese states that, although partial occlusion of the bowel is present in about one-half the cases, complete occlusion practically never develops from the presence of "sarcoma." He points out that even in large tumors encroaching upon the intestinal lumen a narrow passage can be demonstrated, a fact which explains the relative frequency of symptoms of chronic intermittent obstruction associated with this tumor. The occurrence of stenosis is dependent upon a fibrosis and contraction in the tumor which may develop late in the disease. Occasionally polypoid tumors may occlude or constrict the intestinal lumen, producing a stenosis, as occurred in the case reported by De Noyelles. In some instances, the stenosis of the bowel is due to the marked involvement of the mesenteric lymph-nodes which tend to aid in the compression of the lumen of the bowel. Lecene found only two instances of occlusion in a series of eighty-nine cases of sarcoma of the small intestine. This finding is in accord with the observation of Libman, Speese, Ewing, Rankin, and others who believe that occlusion in the course of lymphosarcoma is rare. However, a strikingly contradictory observation is recorded by Liu. In his series of twelve cases, stenosis of the intestinal lumen was present in ten cases of the annular type and in two cases of the polypoid type.

Intussusception is not an uncommon occurrence with lymphosarcoma of the intestines and is noted in sixteen cases. Kasemeyer collected 284 cases of intussusception of the intestines by tumors and found eighty-five (30 per cent.) were caused by malignant growths, of which fifty-seven were carcinoma and twenty-six sarcoma. Speese collected fourteen cases of intussusception in a series of seventy-four cases operated upon for sarcoma of the

small intestine. The condition is more common in the polypoid than in the annular type of tumor, probably owing to the fact that the annular type is accompanied by an aneurismal dilatation of the infiltrated intestinal walls which do not invaginate so readily. In six of Liu's twelve cases, an intussusception had occurred. They included each of the four polypoidal cases and two of the annular type. Two are in children under ten years of age.

The presence of another tumor of a different cell type in cases of lymphosarcoma is extremely rare. Kriebig reports a case of lymphosarcoma of the ileum associated with an adenocarcinoma of the cæcum.

*Histology.*—The microscopical picture of this tumor is not always a consistent one, for it may show either a small round-cell or large round-cell lymphosarcoma. Ewing has pointed out that these two forms may retain their separate identity, since they appear to arise from two specific types of cells: (1) The reticulum cell of the germ centres of the follicle and of the pulp cord; and (2) the lymphocytes. From the former type of cells there may develop a reticulum-cell sarcoma (large round-cell lymphosarcoma) and from the latter a malignant lymphocytoma. Despite the fact that these two forms may develop under different clinical conditions and perhaps have different etiological factors, they must be classed under one heading, lymphosarcoma, until the exact nature of the relation of the lymphocyte to the reticulum cell is established.

The cellular constituents of lymphosarcoma of the intestines may show some variation in size and shape, depending upon the rate of growth. Usually they appear as large or medium-sized mononuclear cells whose nuclei are rather large and vesicular and contain one nucleolus. The cytoplasm is present in fair quantity and is finely granular. Occasionally, larger cells with two or three nuclei are present. De Noyelles found that the predominating type of cell resembled the transitional mononuclear cell of the blood; mitotic figures are rather common. Varying numbers of small lymphocytes, eosinophiles, and plasma-cells frequently accompany the tumor-cells, suggesting some resemblances to an infectious granuloma and so causing some misinterpretation or uncertainty in the diagnosis of the tumor.

The stroma of the growth consists of a fine connective-tissue network which is sparse in some areas and in others is thickened with a tendency to fibrosis. The cellular elements are irregularly interspersed in this meshwork. A sclerosis and thickening of the gut wall may result from the stimulation of the fibro-elastic tissue and give rise to a scirrrous lymphoblastoma (lymphosarcoma), as noted by Graves. The tumor appears to be vascular owing to the presence of many fine, thin-walled blood-vessels. Some of these blood-vessels are compressed or occluded by the tumor-cells.

The mucous membrane of the intestine shows some necrosis and desquamation of the epithelial cells. The presence of a raw ulcer covered with débris is very common. The muscular coats show a marked replacement of the muscular elements by the tumor-cells, with scattered areas of broken-down or atrophied muscle cells. The serosa is intact and unaltered.

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*Metastases and Adhesions to Other Organs.*—Lymphosarcoma of the intestines is accompanied by metastases in some form or other in practically every case. While it is obvious that a distinction should be drawn between true metastases and adhesions, especially of the intra-abdominal organs, it is unfortunate that in many of the cases reviewed by us that there was either no mention made of such involvement or else no attempt to make such a pathological differentiation other than to include both conditions under the general term of metastasis.

The growth tends to spread early to lymph-nodes in the mesentery of the part of intestines involved. In our series, such involvement occurred in sixty-one cases, was absent in ten cases, and not mentioned in fifty-eight cases. In a series of forty-five autopsies, Lecene found thirty-four instances (75 per cent.) of mesenteric involvement. The early and frequent involvement of the mesenteric lymph-glands may be quite extensive and often militates against a successful operative result which can be obtained only by a thorough removal of the mesentery of the affected bowel together with the tumor. Involvement of the superficial lymph-nodes and of those in the retroperitoneal region and mediastinum is rarely noted. In our own case secondary abscess formation in the involved mesenteric lymph-nodes developed.

In the advanced cases, metastatic involvement of practically every abdominal organ has been found. The kidney, liver and spleen are the organs most frequently involved, the spread being hematogenous in nature. Metastases to other organs occurred in eighteen cases in our series. In this group of cases, the frequency with which the organs were involved is as follows: Kidney, 5; liver, 4; spleen, 4; omentum, 3; gall-bladder, 2; lung, 2; appendix, 1; ovary, 1; left axilla, 1; left elbow, 1; diaphragm, 1; parietal peritoneum, 1; transverse colon, 1. In one of the cases reported by Wortman, extensive metastases were found in the following structures: Kidney, liver, gall-bladder, diaphragm, and between the diaphragm and pericardium. Mack found metastases in the kidney, spleen, gall-bladder, appendix, and omentum. Coley reported a case of lymphosarcoma of the small intestine in which an exploratory or laparotomy was performed for what was considered an inoperable tumor; the patient lived ten years. Metastases developed in the cervical region two years after operation, and in the left axilla and left elbow seven years after operation. These metastases responded well to intensive treatment with Coley's serum and radium, and the patient lived for ten years after the original operation. Molson found metastases in the kidney and also an ischiorectal abscess. In an early but very interesting report not included in our series, Sturzberg cited a case of primary intestinal lymphosarcoma which showed a secondary diffuse infiltration of the meninges.

Involvement of adjacent viscera as a result of direct extension of the tumor to the peritoneal surface of these organs is rather commonly noted at operation or at autopsy. The bladder and uterus are occasionally involved as a result of the pelvic position of the tumor. Lecene studied the frequency of adhesions between the affected loop of bowel and other viscera and

reported intestinal adhesions in twelve cases and adhesions to the bladder in seven cases.

Adhesions to intra-abdominal organs occurred in eighteen cases of our series. The character of the adhesions varied. In this group were: Omentum, 4; mesentery, 3; large intestines, 3; abdominal walls (parietal peritoneum), 2; vagina, 2; uterus, 1; pelvic organs, 1; liver, 1; and small intestine, 1. In most instances, they were sharply localized and in others diffuse. The adhesions were mostly inflammatory in nature, but occasionally adherent to the tumor.

Speese states that there is a relation between the histological variety of the intestinal tumor and the metastases. He points out that the majority of recurrences and metastases occur in the lymphosarcoma or round-cell type of sarcoma, whereas spindle-cell sarcoma has a tendency to remain localized. His explanation is that the latter type (spindle-cell) is more frequently associated with stenosis of the intestinal lumen and consequently is accompanied by signs of acute intestinal obstruction which serve as an indication for an early operation before marked extension or metastases have had time to occur. Graves also points out that the so-called lymphoma, lymphosarcoma and small round-cell sarcoma tend to metastasize more often than the other forms of sarcoma.

*Blood Picture.*—In practically all of the reported cases of this disease in which the blood findings are given, one notes an anæmia and a definite but moderate leucocytosis. The white blood count varies between 10,000 and 15,000 with a relative increase in the polymorphonuclear elements (70 to 85 per cent.). None of the cases was accompanied by blood pictures associated with lymphatic leukemia. These findings would indicate that this disease is not a blood dyscrasia but rather a new growth.

*Differential Diagnosis.*—The differential diagnosis in a case of lymphosarcoma of the intestines is very difficult and is often impossible without an operation. However, there are several interesting clinical and pathological features of lymphosarcoma that may serve to differentiate lymphosarcoma from carcinoma of the intestines. Lymphosarcoma is a rapidly progressive disease, whereas carcinoma has a slow course. The cachexia, anæmia, and wasting is more marked in lymphosarcoma. Intestinal haemorrhage is decidedly less common in lymphosarcoma. Alternating constipation and frequent bloody stools occur in carcinoma. From a clinical standpoint, in patients with suspicious signs and symptoms, it is well to suspect lymphosarcoma when the patient is young (below fifteen years) and carcinoma when over forty years of age.

From a pathological standpoint, obstruction of the intestinal lumen is relatively uncommon in lymphosarcoma owing to the infrequent occurrence of complete occlusion of the intestine, whereas the majority of carcinoma cases show complete obstruction of the lumen. Patients with lymphosarcoma frequently develop a fatal toxæmia without signs of intestinal obstructions, despite the presence of a large tumor. This is explained by the diffuse

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nature of the growth in lymphosarcoma. As this tumor spreads through the submucous layers of the intestines, it gives rise to a long, tubular, sausage-shaped or elongated pouch, constricted at each end. In this manner, lymphosarcoma does not encroach upon the lumen of the bowel sufficiently to obstruct, but is apt to cause dilatation that gives the affected bowel the appearance of an aneurismal pouch. However, in some cases of lymphosarcoma, the diffusion of the growth in the submucous layer may cause a polypoid formation in the shape of single or multiple small pedunculated growths, which may give rise to intussusception and secondary intestinal obstruction. True stenosis of the lumen in lymphosarcoma is rarely due to a cicatricial contraction such as occurs in carcinoma, but usually to the pressure of metastatic glands in the mesentery of the affected bowel. Lymphosarcoma is usually larger, less circumscribed and less freely movable than carcinoma.

Another valuable differential point is the fact that metastases and lymphatic involvement occur late in carcinoma. In practically every case of lymphosarcoma, the mesenteric lymph-nodes show malignant changes, whereas the glands in the mesentery, draining the involved gut in carcinoma, may be enlarged, but show no signs of malignancy. Miller points out that patients with lymphosarcoma of the mesentery without involvement of the intestines are usually free from intestinal and gastric disturbances. He also states that lymphosarcoma differs from the other forms of lymphomas by its characteristic local destructive lesion and the formation of true metastases in distant organs.

*Pre-operative Diagnosis and Indications for Operations.*—It appears that the most probable pre-operative diagnosis in a case of lymphosarcoma of the intestine would be either an acute or chronic intestinal obstruction, inasmuch as practically every case is accompanied by some degree of obstruction or such conditions as intussusception, stenosis, or adhesions. A more positive diagnosis can be made in the face of an acute or chronic intestinal obstruction when there is a palpable tumor present of more than a few days' duration and a neoplasm is suspected.

To venture a more definite diagnosis than the presence of a neoplasm is extremely hazardous, in view of the multitude of conditions that may present a similar picture or one extremely difficult to differentiate from intestinal lymphosarcoma.

The pre-operative diagnosis is stated in ninety-one cases of our series. There were only two cases correctly diagnosed before operation without such technical aids as X-ray examinations or biopsies: (1) Weeden's (Case XIV) lymphosarcoma of the intestines in a man, thirty-five years old, who had undergone appendectomy five months previously; and (2) Cabot's acute intestinal obstruction and lymphosarcoma of the intestines. In the case reported by Guliani, a tentative diagnosis of lymphosarcoma of the intestines, or cyst of the mesentery, was made before operation. There were five cases in which the diagnosis of lymphosarcoma of the rectum was made

by biopsy: Rankin and Chumley, two cases; Bensaude, Cain, and Horwitz, two cases; Stolz, Gunsett, and Oberling, one case. In one of the two cases reported by Bensaude, Cain, and Horwitz, a diagnosis of malignant lymphoma was made from biopsy of the cervical lymph-node two years previous to the biopsy of the rectal lymphosarcoma.

There were seven cases in which X-ray examination rendered valuable assistance in detecting the presence of an intestinal neoplasm and establishing the latter as a tentative diagnosis before operation. The X-ray diagnosis in these cases were: (1) Puccinelli—tumor in the small intestines not connected with stomach or colon; (2) Silver—partial obstruction of small bowel due to tumor; (3) Kelly—six areas of dilatation in the small intestines due to tumor; (4) Golob—complete obstruction near splenic flexure; (5) Friend—malignancy of hepatic flexure; (6) Goodman—malignancy of transverse colon; and (7) Weeden (Case IX)—obstruction at splenic flexure.

In the following group of thirty-five cases, the diagnosis was not conclusive in regard to the etiological factor, but sufficiently accurate to serve as a definite indication for operation.

(1) <i>Intestinal Obstruction</i>		(4) <i>Malignancy</i>	
(a) Acute.....	6	(a) Transverse colon.....	1
(b) Acute with intussusception.....	3	(b) Ileocecal.....	1
(c) Type not mentioned.....	3	(c) Jejunum.....	1
(2) <i>Intussusception</i>		(d) Bowel.....	
(a) Intussusception with tumor.....	1	(e) Gastro-intestinal tract.....	1
(3) <i>Tumor</i>		(f) Probably sarcoma.....	1
(a) Abdominal.....	3	(5) <i>Miscellaneous</i>	
(b) Intestinal.....	2	(a) Ileus.....	2
(c) Cecal.....	1	(b) Acute abdominal condition.....	1
(d) Rectal.....	1	(c) Perforative peritonitis.....	1

The diagnosis was incorrect in a rather large group, as indicated in the forty-one cases listed below:

(1) <i>Appendicitis</i>		(3) <i>Biliary Diseases</i>	
(a) Acute.....	4	(a) Gall-bladder disease.....	1
(b) Acute with abscess.....	2	(b) Gall-stones.....	1
(c) Acute with perforation.....	1	(c) Catarrhal jaundice.....	1
(d) Acute with peritonitis.....	1	(d) Cirrhosis of liver.....	1
(e) Acute or with stercoæmia.....	1	(4) <i>Colitis</i>	
(f) Acute or with tuberculous peritonitis.....	1	(a) Chronic ulcerative colitis.....	1
(g) Chronic.....	3	(b) Enterocolitis.....	1
(h) Chronic and jejunal carcinoma.....	1	(c) Colitis.....	1
(2) <i>Tuberculosis</i>		(d) Dysentery.....	1
(a) Mesenteric lymph-nodes.....	2	(5) <i>Ulcer</i>	
(b) Peritonitis.....	2	(a) Gastric.....	1
(c) Ulcer.....	1	(b) Duodenal with perforation.....	1
(d) Ulcer with perforative appendicitis ..	2	(6) <i>Gynaecological</i>	
(e) Cæcum and colon.....	1	(a) Right salpingitis.....	1
(f) Stenosis producing obstruction.....	1	(b) Sarcoma of uterus.....	7

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(7) <i>Mesentery</i>			
(a) Sarcoma . . . . .	1	(b) Generalized dropsy . . . . .	1
(b) Cyst . . . . .	1	(c) Pancreatic insufficiency . . . . .	1
(8) <i>Miscellaneous</i>		(d) Duodenal stenosis below ampulla due to stenosis . . . . .	1
(a) Kidney tumor . . . . .	1		

Many authors, including Libman, Jopson, and White, have stressed the frequency with which lymphosarcoma of the intestines has been diagnosed as acute appendicitis. In fact, Miller states that the diagnosis of acute appendicitis is made oftener than any other. Occasionally, a diagnosis of appendicular abscess with chronic intestinal obstruction is made, as occurred in one of the cases reported by Liu. Earlier contributors to the subject state that other intra-abdominal conditions with which this has been confused are retroperitoneal tumors, neoplasms of the bladder or prostate, carcinomatosis of the abdomen secondary to malignancy in the ovary, and gynaecological conditions such as uterine myomata and ovarian cysts.

In cases of lymphosarcoma which are accompanied by icterus, carcinoma of the liver or head of the pancreas with intestinal involvement may be suspected. The presence of pressure symptoms such as ascites, edema of the legs, or distention of the veins of the abdomen and thorax, may lead to confusion and an erroneous diagnosis of a retroperitoneal tumor. In the rare cases of perforation of the tumor mass, a diagnosis of peritonitis may be made with the primary cause unsuspected.

It is possible that X-ray examination in the early cases might reveal a lesion in the small intestines. In tumor studies of the large bowel, X-ray studies are of immense value. With the recent refinements of X-ray technique, studies should not be limited to the stomach or large bowel, as has been stressed by Rankin.

When the clinical picture suggests intestinal obstructions, the administration of contrast substances by mouth is not only unnecessary, but often a dangerous procedure. It is not an infrequent experience of surgeons and röntgenologists to note the transformation of an incomplete obstruction into a complete one, following the administration by mouth of opaque substances for X-ray diagnosis. However, in cases of suspected obstructions due to tumors in the large intestines, X-ray examination following the injection of opaque substances as an enema into the rectum is clearly indicated and of great value.

X-ray examination without the use of opaque media in cases of intestinal obstruction has been the subject of recent study by European investigators, including Schwartz, Assman, Haesslin, Weil, Bensaude and Grenaux, Kloiber, and others; and by the following Americans: Case, Kalbfleisch, Meyer and Brams, Davis and Rabwin, and Ochsner and Granger. Their studies show that the presence of distended loops of intestines filled with gas and fluid is strongly suggestive of intestinal obstruction. The diagnosis is confirmed by the appearance of fluid levels in the intestinal loops. The fluid levels can be demonstrated best when the patient is placed in

the upright position, or when lying on the side if he is too weak to move. Positive findings have been observed as early as five and one-half hours after obstruction.

These signs are found not only in obstructions in the large bowel, but also in cases in which the obstruction is in the small bowel, and hence this procedure offers an invaluable aid in diagnosis of the latter type of cases, which usually are the most difficult to diagnose. Case has stressed the importance of gaseous distention in obstructions of the loop of small bowel; the parallel course of the coils of the intestines and the serrated contour of the bowel are characteristic findings. Weil emphasized the importance of multiple fluid levels in obstructions of the small intestines, since normally no air is contained within the jejunum.

As mentioned above, X-ray examinations have proved to be helpful in establishing an accurate diagnosis of an intestinal tumor in the following cases: (a) Small intestine (Puccinelli, Silver, and Kelly); and (b) large intestine (Golob, Friend, Goodman, and Weeden).

Despite the fact that a complete study of the clinical picture and laboratory investigation reveals no typical findings characteristic of lymphosarcoma of the intestines, especially in the cases in which no tumor mass is palpable, the indications for operative interference should be the presence of symptoms of an acute or chronic intestinal obstruction. It is only by early (operative) treatment of this disease that good results can be obtained. No surgeon can afford to be too conservative in his treatment of cases of chronic intestinal obstruction in which the etiological factor is obscure or unexplained.

#### CASE REPORT

CASE No. 9591.—A. S., white, male, thirty-three years old, married, Jewish, butcher. Admitted to Sinai Hospital, February 27, 1927, 9:30 P.M. *Complaint.*—Pain over entire lower abdomen. *Family History.*—Unimportant.

*Past History.*—Has always been in good health, except for measles as a child and frequent sore throats in adolescence, which necessitated a tonsillectomy six years ago. No history of syphilis or gonorrhœa.

*Present Illness.*—During the past six weeks has had several attacks of cramps, especially pain in the lower abdomen below the level of the umbilicus. The pain did not radiate and has gradually increased in severity. Attacks of pain were not accompanied by nausea, vomiting, chills, fever, jaundice, haematemesis, or melena; they lasted from one to two hours. There was no relation to meals or exercise. No history of trauma obtained. There has been a moderate degree of constipation during the present illness. There have been no symptoms referable to the cardio-respiratory, genito-urinary, or neuro-muscular systems.

*Physical Examination.*—The patient was well developed and well nourished and did not appear acutely ill or toxic. Temperature, pulse, and respiration were normal on admission. Examination was negative except for the abdomen, which was full, round and of good muscle tone. There were no evidences of fluid, hernia, or masses. Liver, spleen, and kidneys not palpable. There was some spasticity and rigidity of the lower right rectus muscle. Definite tenderness was elicited in the right lower quadrant, especially over McBurney's area and to the left of the umbilicus. Intestinal patterns and peristaltic waves were not present.

*Laboratory Findings.*—Urine negative. Hemoglobin, 70 per cent.; red blood-cells,

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4,700,000; leucocytes, 8,500, with 90 per cent. polymorphonuclears. *Pre-operative Diagnosis.*—Subacute appendicitis.

*Operation.*—This was performed on the following morning, February 27, 1927, under ether anaesthesia. Through a McBurney incision, the cæcum and appendix were delivered and the appendix removed by cautery. The ligated appendiceal stump was not inverted. In view of the fact that the appendix appeared to be practically normal in appearance, further exploration of the large and small bowel was made and an annular growth was discovered in the terminal portion of the ileum about twelve centimetres from the ileocecal valve. The tumor mass was three centimetres long and in the centre was a ring-like depression, causing a circular constriction, two centimetres in diameter, of the tumor mass and a stenosis of the intestinal lumen. The serosa over the mass was intact and indicated that the tumor had originated in the intestinal wall. The tumor was not adherent to any other intra-abdominal organ.

In the mesentery attached to this section of the bowel were found two large inflammatory masses in addition to several enlarged mesenteric lymph-nodes. The upper of the two inflammatory masses in the mesentery measured approximately eight centimetres in diameter; it was reddish and indurated in the periphery and soft in the centre. When incised, this mass emitted a thick, greenish, foul-smelling pus. A culture of the pus revealed colon bacilli and streptococci. The lower inflammatory mass was about four centimetres in diameter and showed less congestion and induration. Incision of this mass revealed a grayish necrotic material, presumably broken-down glands.

Approximately nine centimetres of ileum containing the tumor and a small portion of the adjoining mesentery were removed. The cut ends of the ileum were inverted and reinforced with mattress sutures and a lateral anastomosis between the cut portions of ileum was made in the usual manner. After its completion, the abscessed areas in the mesentery were then incised and drained with two cigarette iodoform drains. The abdominal incision was closed in layers in the usual manner.

*Course in the Hospital.*—Excepting for a very slight temperature elevation (not exceeding 101° F.) during the first four days after operation, the patient made an uneventful recovery and was discharged on the twenty-seventh day after operation (March 27, 1927) with the wound entirely closed.

*Pathological Report.*—The macroscopical specimen consisted of a piece of ileum measuring nine centimetres in length. The tumor was annular in shape with a central constricting zone. The walls were markedly thickened. The mucosa was intact and smooth. The growth was of soft consistency. When the tumor was cut in the long diameter of the intestine, the constricting zone was found to measure 2.5 centimetres in diameter and produced an almost complete stenosis of the bowel, the lumen admitting only one finger. The mucosa was smooth and showed no areas of ulcerations.

At one end of the slide, glands of the type that are found in the small intestines, together with normal mucosa, submucosa and muscularis were noted. As we moved along, the mucosa was elevated and the glands distorted. The elevation of the mucosa was due to the active growth and proliferation of the lymphoid tissue of the submucosa. In some areas, very little remained of the mucosa. There was a marked invasion and replacement of the muscularis by the lymphoid tissue and some extension of the tumor into the mucosa.

The tumor was composed of tissue closely resembling lymphoid glands excepting that an absence of germinal centres was noted. The cellular morphology varied somewhat, but the majority of the cells were of the large mononuclear type. Little or no endothelial hyperplasia were found. There were no cells of the Dorothy Reed type. The tumor obviously arose from the lymphoid tissue of the submucosa. None of the mesenteric lymph-nodes were obtained for microscopical study. *Diagnosis.*—Lymphosarcoma of ileum.

*Note.*—This diagnosis was confirmed by Drs. L. Sachs and S. Cone, pathologists at Sinai Hospital. Dr. S. McCleary, pathologist at Mercy Hospital, considered the

tumor a lymphoblastoma. Dr. J. C. Bloodgood examined sections of this tumor and called it a chronic inflammatory tumor or sarcoma and compared this tumor to those studied by Liu in his laboratory.

*Subsequent Course.*—Deep X-ray therapy was advised and urged upon discharge from the hospital, but the patient refused to coöperate. He remained in apparently excellent health for four months after the operation, but then began to complain of abdominal pain and distress and presented signs of recurrence of growth. He gradually became weaker and died of a recurrence of the growth six months after operation.

*Treatment.*—Whatever success is associated with the treatment of lymphosarcoma of the intestines is directly dependent upon an early diagnosis and the institution of prompt treatment. The rapidity of growth and the marked invasive and metastatic tendencies of this tumor are responsible for the usual unsatisfactory results. It appears that in cases in which the tumor is more or less localized and the lymphatic involvement is not too extensive, surgery in the form of resection of involved gut offers the best results from a curative or palliative standpoint. If the growth is so extensive as to make a resection impractical or an extreme risk, a palliative procedure such as a side-tracking operation (entero-enterostomy, ileocolostomy, ileosigmoidostomy) or drawing a loop of bowel to the outside to make an artificial anus (colostomy, *etc.*) is indicated. The last-mentioned operative procedure is particularly adaptable to extensive tumors with an accompanying stenosis. Should inspection reveal an extensive infiltrating growth with metastases, it is the better part of discretion and valor to close the abdomen without further manipulation.

Since a large percentage of the cases are complicated by an intussusception or stenosis, the indication for operation almost always lies in an intestinal obstruction of the acute or chronic type. The choice of the operative measure to be carried out can be decided only at the operating table, but should always aim to relieve immediate and urgent symptoms, and, if possible, to effect a probable cure by a thorough resection of the involved gut. One cannot stress too much the fact that delay in instituting treatment militates against a good operative result. Rankin feels that the end-results of the surgical treatment of this condition from the standpoint of prolonging life are rather poor. He is opposed to surgery other than a palliative procedure, excepting in those cases in which an early diagnosis has been made. It appears, however, that the best results in the treatment of lymphosarcoma are obtained by a radical excision of the tumor mass at the earliest possible date, followed by irradiation.

Minot and Isaacs state that irradiation of this type of tumor is beneficial because it alleviates the symptoms and decreases the size of the lesions. They point out that irradiation improves the patient's general condition and efficiency, but apparently does not influence the duration of the disease. Desjardins and Ford are of the opinion that, while radiation may or may not cause definite prolongation of life, it does keep the disease under complete or partial control for varying lengths of time. It is a well-known fact that malignant lymph-nodes of the abdominal cavity respond very poorly to Röntgen-ray treatment. When radiation is used as a palliative or post-operative pre-

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ventive measure, it is frequently followed by nausea, vomiting, or severe gastro-intestinal disturbances, and hence must be carefully controlled.

The use of radium has been advocated in the treatment of lymphosarcoma of the intestines as a result of its success in the treatment of carcinomatous and lymphosarcomatous conditions in other parts of the body. Bloodgood maintains that radium affords a surer means of effecting a cure in lymphosarcoma than surgery. The difficulties of making an accurate pre-operative diagnosis and the inaccessibility of lymphosarcoma of the intestines to radium applications other than through an abdominal incision would tend to offset its value in this particular affliction. However, we feel that radium as a palliative measure should be used in the inoperable cases wherever possible.

The internal use of arsenic and other metallic salts was once in great vogue in the treatment of lymphosarcoma of the intestines, as evidenced by its frequent use among the earlier writers on the subject. Large doses were given over long periods of time, and transient or temporary improvement was reported in some instances. The results of such medication have never been satisfactory and its use has been discarded. In our series, arsenic in the form of salvarsan was employed in conjunction with operation and radiation in only one case (Zimmer).

The type of treatment used in the series of 126 cases collected by the authors was predominantly surgical. In 103 cases, operative treatment in the form of intestinal anastomosis, with or without radical removal of the tumor segment and gland-bearing area, was carried out. These groups are reported in greater detail later. Radiation was employed in twenty-eight cases as a post-operative measure to prevent recurrence in twenty cases; as a palliative procedure as soon as the diagnosis of an inoperable tumor was established by an exploratory laparotomy in two cases; after a diagnosis had been made by biopsy in four cases; before operation in one case; and in one patient was not operated upon. Coley's serum was used in two cases with good results. In Coley's case, it was combined with radium, and in Battle's case, it was after the third operation in a patient who was submitted to five operations. Radium was used in three cases; in two cases (Coley's and De Noyelles') as a palliative procedure supplementing operation; and in one case (Rankin and Chumley) for curative purposes after a diagnosis of rectal lymphosarcoma has been made by proctoscopic examination and biopsy. In eleven cases, an exploratory laparotomy was performed and an inoperable tumor was found; one of these patients (Loria) had a generalized peritonitis also and drainage was instituted.

### THE OPERATIVE TREATMENT OF LYMPHOSARCOMA OF THE INTESTINES

Operation was performed in 114 cases in our series, eleven were exploratory laparotomies (Wortman, Lotter, Macked, Carlo, Beer, Loria, and Weeden—five cases). In the remaining 103 cases, a palliative or side-tracking operation was performed in eight instances, and a resection and an anas-

tomosis in seventy-four cases. In addition, there were eleven cases in which more than one operation was performed at different intervals of time. There were ten cases in which the type of operation performed was not mentioned.

TABLE I  
*Resection Plus Anastomosis Group*

(a) Lateral anastomosis of small intestine.....	5
(b) End-to-end anastomosis of small intestine.....	22
(c) End-to-end anastomosis of small and large intestine.....	1
(d) End-to-end side of large and small intestine.....	1
(e) Gastroenterostomy.....	2
(f) Ileocolostomy.....	9
(g) Colostomy.....	3
(h) Double resection of small intestine and anastomosis (puccinelli).....	1
(i) Double resection with lateral anastomosis of jejunum and end-to-end of large intestine (Fannesci).....	1
(j) Triple resection type of anastomosis not mentioned.....	28
<i>Total</i> .....	74

*Palliative Operations*

(a) Appendectomy.....	2
(b) Closure of perforation.....	1
(c) First-stage Mikulicz.....	1
(d) First-stage Mikulicz plus caecostomy.....	1
(e) First-stage Mikulicz plus caecostomy and appendectomy (Golob).....	1
(f) Lateral anastomosis of small intestine and lateral anastomosis of large intestine (Fannuci).....	1
(g) End-to-end anastomosis of small intestine plus lateral ileocolostomy.....	1
<i>Total</i> .....	8

TABLE II

*Cases in Which More Than One Operation was Performed at Different Time Intervals:*

Author	First Operation	Second Operation	Intervals of Time
Fisher	Exclusion of tumor plus ileo-colostomy	Radical resection	Not mentioned
Perry	Side-to-side anastomosis	Enterostomy for adhesions	1 week
Fullerton	Resection plus end-to-end anastomosis	Resection plus end-to-end anastomosis for pain and mass	42 days
Simoncelli	Resection plus end-to-end anastomosis	Resection plus end-to-end anastomosis	1 year
Pissarewa	Reduction of intussusception	Reduction of intussusception (too weak for resection)	3 weeks
Friend	Appendectomy	Operation for partial obstruction (type)	2 weeks
Hagyard	Appendectomy and caecotomy	Ileocolostomy and Mikulicz	Not mentioned
Weeden	Enterico-anastomosis	Resection	26 days
Liu	Resection anastomosis and reduction of intussusception	Exploratory laparotomy (growth inoperable)	Not mentioned

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TABLE II—(Continued)

Author	First Operation	Second Operation	Intervals of Time
Battle	Intussusception reduced (5 operations)	<ul style="list-style-type: none"> <li>(a) Intussusception reduced plus lateral anastomosis</li> <li>(b) Removal of growth and end-to-end anastomosis</li> <li>(c) Exploratory laparotomy</li> <li>(d) Resection of recurrent tumor plus lateral anastomosis</li> </ul>	Over a period of 3 years
Koch	Suture of ulcer plus enterostomy to exclude ulcer portion of intestines (4 operations)	<ul style="list-style-type: none"> <li>(a) Resection of 1.8 meters of ileum with end-to-end anastomosis</li> <li>(b) Release of adhesions</li> <li>(c) Release of adhesions with side-to-side anastomosis</li> </ul>	Not mentioned

The amount of gut resected is mentioned in forty-four cases of our series. In each instance, the tumor-bearing segment was resected, and in three instances, it was necessary to perform an additional resection of adjacent loops or portions of intestines involved by adhesions or extension of tumor (Fannucci and Puccinelli) or intussusceptions (Liu, Case VII). The following table indicates the exact amount of intestines resected in each case:

TABLE III  
*Amount of Intestine Removed*

<i>Small Intestines</i>		<i>Large Intestines</i>	
12 cm. jejunum	Weeden (Case VII)	40 cm. small intestines	Graef
12 cm. jejunum	Valdo	40 cm. small intestines	Puccinelli
25 cm. jejunum	Puccinelli	45 cm. small intestines	Mirotworzew and Sacharow
35 cm. jejunum	Brun	45 cm. small intestines	E. M. Fisher
35 cm. jejunum and 1 year later	Simoncelli	50 cm. small intestines	Kricke
14 cm. small intestine	Simoncelli	50 cm. small intestines	Miller
9 cm. ileum	Authors' case	60 cm. small intestines	Perez
20 cm. ileum	Guliani	75 cm. small intestines	
40 cm. ileum	De Noyelles	1.45 m. small intestines (Double resection)	Puccinelli
50 cm. ileum	Simoncelli	1.5 m. small intestines	
50 cm. ileum	Rankin	1.52 m. small intestines	Kelly
60 cm. ileum	Liu (Case V)		
70 cm. ileum	Silver		
80 cm. ileum	Puccinelli	15 cm. sigmoid	Goodman
92 cm. ileum	W. H. Fisher	14 cm. rectum	Brun
1.6 cm. ileum	Puccinelli		
Triple resection (amt.)	Liu (Case VII)		
Tumor segment (amt.)	Fullerton		
8 cm. small intestines	Bendetti, Valentine		
14 cm. small intestines	Douglas		
30 cm. small intestines	Wortman		
35 cm. small intestines	Peterson		
<i>Small and Large Intestines</i>			
10 cm. ileum plus cæcum		10 cm. ileum plus cæcum	Liu (Case XI)
10 cm. ileum plus cæcum		10 cm. ileum plus cæcum	Graham
34 cm. ileum plus cæcum plus 25 cm. of ascending colon		34 cm. ileum plus cæcum plus 25 cm. of ascending colon	Kriebig
20 cm. duodenum plus cæcum plus ascending colon		20 cm. duodenum plus cæcum plus ascending colon	Rankin

<i>Small and Large Intestines (cont'd)</i>			
5 cm. ileum plus cæcum plus ascending colon plus 10 cm. of transverse colon	Perry	Ileum plus cæcum Ileum plus cæcum plus ascending colon	Liu (Case X) Liu (Case LX)
5 cm. jejunum plus two-thirds of sigmoid plus distal part of descending colon (double resection)	Fannetti	Terminal ileum plus cæcum plus ascending colon plus hepatic flexure Ileocecal mass	Thomson Condat

The question of resection of the various portions of the intestinal canal in the operative treatment of this condition is of extreme importance to the surgeon. Experiments on animals and series of human cases have proved that the whole or any portion of the large intestine may be removed without jeopardizing life. On the other hand, the removal of large amounts of small intestine has a more serious aspect as affecting the condition of the patient.

In 1912, Flint collected reports of fifty-nine cases of extensive resection of the small intestine with forty-eight recoveries. Speese (1914) found over fifty-four cases with fifty-three recoveries. Watson (1923) was able to find seventy-two recorded cases of extensive resection of the small intestine. Jerauld and Washburn (1929) studied the reported cases of extensive resection of the small intestine (more than 200 centimetres, or six feet seven inches) and state that the total number of such cases recorded to date is well under 100.

Many of the cases of extensive resections reviewed by the authors were attended by relatively good results and are worthy of further mention. Perez resected seventy-five centimetres of the small intestine in a male, aged thirty-seven years, who was reported as being in excellent health seven years after operation. T. H. Kelly resected about five feet (152 centimetres) of small intestine, beginning at the duodenum, in a female patient, aged thirty-four years, who was alive and well nine months after operation. Puccinelli reported three cases with resections of more than one metre: (1) Male, forty-six years old, had 1.6 metres of ileum removed and lived for three years with no recurrence; (2) male, thirty-one years old, had 1.5 metres of small intestine resected and lived for three months, but had a recurrence of the growth; (3) male, twenty-six years old, was subjected to a double resection of the small intestine with the removal of 1.45 metres of gut and lived for fourteen days, death resulting from intestinal haemorrhage. Perry's patient was alive and well five and one-half years after a resection of five centimetres of the terminal ileum, the entire cæcum and ascending colon, and ten centimetres of the transverse colon. One of the patients operated upon by Rankin had twenty centimetres terminal ileum, cæcum and ascending colon resected, and made an uneventful recovery, but died four months after operation from recurrence. Kriebig and Weeden (Case XI) reported cases living and well one year after resection of the terminal ileum, cæcum, and ascending colon. Thomson's patient, male, aged fifty years, lived seven years, nine months, after resection of the terminal ileum, cæcum, ascending colon, and hepatic flexure, dying of pneumonia, notwithstanding the fact that he had recurrence in rectum and mediastinum two years after operation which responded well to deep X-ray treatment.

The immediate mortality in these cases of extensive resection was very low. The only patient dying within twenty-four hours of operation was reported by Fannuci. His patient was subjected to a double resection: (1) Five centimetres jejunum, and (2) two-thirds of the sigmoid plus the distal portion of the descending colon, and died of

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cardiorespiratory insufficiency. Liu's patient (Case VII) had a triple resection of the small intestine, but died on the fourteenth day after operation of a pulmonary embolus.

Treves examined 100 bodies and found the average length of the small intestines in the male to be twenty-two feet, five inches, and in the female, twenty-three feet, five inches. The shortest small intestine was fifteen feet, six inches, and longest, thirty-one feet. Thus a resection of 200 centimetres (six feet, seven inches) may almost equal one-half the length of the small intestine, but usually is equivalent to about one-third of the total length.

Flint studied the effect of resection of varying amounts of the small intestine in dogs and found that resection of as much as 50 per cent. of the total intestine may be accomplished without fatal results. A gradual return to a practically normal condition as regards weight and metabolism follows such a resection, if the animal is maintained on favorable diets after operation. Resection of 75 per cent. or more of the small intestine may be survived but the animals do not return to normal weight, even after the establishment of a good compensatory process. Flint found that the compensatory process following resections of the small intestine consists of a hypertrophy and a hyperplasia of the remaining portion of the small intestine, but with no regeneration of the villi and crypts.

Speese pointed out that human patients behave, in general, like animals, in showing similar metabolic disturbances. Jerauld and Washburn are of the opinion that 200 centimetres is the limit of resection, and that beyond this serious metabolic disturbances may result. They found that some persons are apparently not affected by a resection of one-third of the small intestine, but that others have a diarrhoea. They advocate a diet rich in carbohydrates and nitrogenous substances and poor in fat for patients in whom an extensive resection has been done. In these cases, death results from decompensation due to improper diet after many years of apparently good health.

The degree of digestive and metabolic disturbance appears to be greater following resections of the small intestine, than of the large intestine. Likewise, the removal of the proximal portion of small intestine is attended by more serious consequences than the removal of the distal portion. Furthermore, it has been definitely shown that neither the stomach nor the colon are able to compensate for the loss of large portions of the small intestines. It is of paramount importance for the surgeon to resect the minimal amount of intestine consistent with the pathological changes present, and to leave an amount of small intestines sufficient for compensatory purposes in order to forestall the development of digestive disturbances and inanition.

It is interesting to note that successful resections of over 400 centimetres of the small intestines are on record. In 1923, Doerfler reported the largest successful resection which was done for volvulus of the entire bowel of thirty hours' duration. After resection of the gangrenous bowel, there remained twelve centimetres (four and three-quarter inches) of the upper segment at the duodeno-jejunal flexure and twenty centimetres (eight inches) of the lower segment at the cæcum. These segments were joined by a side-to-side anastomosis and the reconstructed portion measured only twenty-four centimetres (9.12 inches). His patient was fifty-eight years of age, and was in perfect health six years after operation.

Jerauld and Washburn report a case in a man of thirty-six years, in which nineteen feet (570 centimetres) of gangrenous intestine (approximately two-thirds of the small bowel) had been successfully resected. The patient survived a second operation for in-

testinal obstruction and was alive and well two and one-half years after operation. Brenner (quoted by Denk) resected 540 centimetres (seventeen feet, nine inches) of gangrenous small intestine for a strangulated hernia in a female of sixty-one years. The patient made a good recovery, but died of marasmus two and one-half years after operation. In 1907, Storp reported the successful resection of 510 centimetres (sixteen feet, nine inches) of small intestine, including all of the ileum and part of the jejunum for a sarcoma of the mesentery in a male aged twenty-one years. The patient made an excellent recovery and gained weight, but unfortunately died five months after operation, from a recurrence of the sarcoma.

*Prognosis.*—The earlier writers on the subject of lymphosarcoma, or sarcoma of the intestines, particularly Baltzer and Libman, assume a very pessimistic attitude in regard to the prognosis, inasmuch as they believed that the condition was invariably and rapidly fatal. This is, of course, true for the untreated cases, but a more optimistic view can be taken in the treated cases, especially those operated on early in the course of the disease. Treatment in the form of surgery may not offer a permanent cure, but it has served to prolong life several months or years, especially when combined with irradiation. In the literature of the past few years, one notes frequent reports of patients who have lived from one to eight years after operation with no recurrences of the growth.

Speese collected seventy-four cases of resection of the small intestine for "sarcoma." In this series, there were fifty-five recoveries, nineteen deaths following operation, and nine recurrences at varying periods (three months to fifteen months). His figures are very interesting and are quoted in full:

Number of patients dying within twenty-four hours after operation . . . . .	10
Number of patients dying within one week after operation . . . . .	11
Number of patients dying within one year after operation . . . . .	12 (cause of one death was metastases)
Number of patients showing no recurrence . . . . .	21
After 3 months 2	After 12 months 1
After 4 months 1	After 16 months 1
After 5 months 1	After 18 months 1
After 6 months 2	After 27 months 1
After 7 months 1	After 3 years 2
After 8 months 1	After 4 years 2
After 9 months 1	After 8 years 1
After 10 months 2	After several years 1

In twenty-three cases, no subsequent history was obtained.

However, the recent advances in operative technic and the greater attention to post-operative care have brought about a reduction in operative mortality with increased prolongation of life.

A study of the mortality and morbidity in the 103 operative cases in our series disclosed some interesting information. In eighty-five cases, the length of life after operation was definitely stated; in nine cases, operative recovery occurred, but no mention was made of the duration of life after operation;

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and in nine cases, no history was obtained of an operative recovery or of the length of life after operation.

In the former group (eighty-five cases), nine died within twenty-four hours after operation, and six within forty-eight hours, giving an immediate operative mortality of 17.6 per cent.; fifteen (17.6 per cent.) died within the first year after operation; and thirty (35.2 per cent.) lived more than a year. Twenty-five (29.4 per cent.) died within the first year after operation.

Further analysis of the thirty patients who lived more than one year showed:

- (a) 9 alive from 1 to 2 years after operation
- (b) 4 alive from 2 to 3 years after operation
- (c) 5 alive from 3 to 4 years after operation
- (d) None alive from 4 to 5 years after operation
- (e) 4 alive from 5 to 6 years after operation
- (f) None alive from 6 to 7 years after operation
- (g) 5 alive from 7 to 8 years after operation
- (h) 1 alive from 8 to 9 years after operation
- (i) None alive from 9 to 10 years after operation
- (j) 1 alive from 10 to 11 years after operation
- (k) 1 alive from 11 to years after operation

The average duration of life for the group of eighty-five operated cases was 569.4 days, or approximately nineteen months.

Recurrence after operation occurred in twenty cases, which is seemingly a low figure and is explained by the fact that in many of the case reports the necessary data were lacking. The time of recurrence was stated in eleven cases as follows:

After 1 month.....	3
After 2 months.....	1
After 3 months.....	1
After 4 months.....	2
After 6 months.....	1
After 10 months.....	1
After 2 years.....	1

In one case (Simoncelli) recurrence was noted four months after the first operation and two months after the second operation. There were ten patients alive and well five years or more after operation, with no evident signs of recurrence.

5 years.....	3 cases (Gerster, Douglas, Liu—Case XII)
5½ years.....	1 case (Perry)
7 years.....	3 cases (Battle, Perez, Liu—Case X)
7 years 9 months	1 case (Thomson)
8½ years.....	1 case (Liu—Case VIII)
11 years.....	1 case (Moir, Walker)

The cause of death is mentioned in one non-operative case and in twenty-four operative cases. The non-operative case (Clopton) died of bronchopneumonia. The cause of death in the twenty-four operative cases was as follows:

(1) Generalized lymphosarcomatosis . . . . .	Guliani, Wortman
(2) Recurrence of metastasis . . . . .	Valdes, Simoncelli, Rankin, and Chumley (2 cases)
(3) Exacerbation of growth with haematuria and thrombosis of both legs . . . . .	Lehmkuhl
(4) General peritonitis . . . . .	Golob, Koch, Pisarewa
(5) General peritonitis with strangulated hernia . . . . .	Cabot
(6) General peritonitis and pleurisy . . . . .	Friend
(7) Haemorrhage from the bowel . . . . .	Fisher, Puccinelli
(8) Shock . . . . .	Miller
(9) Bronchopneumonia . . . . .	Rankin
(10) Bronchopneumonia and pulmonary abscess . . . . .	Puccinelli
(11) Pulmonary embolism . . . . .	Liu
(12) General asthenia . . . . .	Goodman, Hneider
(13) Cachexia . . . . .	Carlos, Bensaude, Cain and Horwitz
(14) Cachexia and vomiting . . . . .	Wortman
(15) Cardiorenal insufficiency . . . . .	Fannucci

The most frequent cause of death occurring within a short time after operation is a general peritonitis. In the patients dying some time (months or years) after operation, recurrence or metastasis is responsible for the death.

In the series of twelve operative cases reported by Liu, there was one operative death. Four patients were living and free of recurrence from one and one-half to six years after operation, and only two patients died of recurrence between two and three months after operation. Miller cited patients living two to eight years after operation. In Rankin and Chumley's series of fifteen operative cases, treated by resection and receiving radiation after operation, five died of recurrence. Four of these died with an average life period of four and one-half months, and one was living at the time of report but had a recurrence. Two of the five that died had a generalized form of recurrence. Thomson reported the case of one patient with lymphosarcoma of the ileocecal coil treated by extensive resection, who developed a recurrence in the form of rectal and mediastinal lymphosarcoma two years after operation, which responded well to deep X-ray treatment. Simoncelli reported a case of lymphosarcoma of the jejunum with recurrence four months after operation. A year after the first operation, a second operation was performed with another recurrence two months later. The patient died one year and five months after the first operation.

#### CONCLUSIONS

The authors have collected 125 cases of lymphosarcoma of the small and large intestines in addition to the case herewith reported, making a total of 375 cases to date. The majority of the cases in our series have been reported since the publication of Graves' article in 1919, while several of the cases antedate, but were not included in, Graves' series. A statistical study of the clinical and pathological data in the 126 cases collected by the authors warrants the following conclusions:

(1) Lymphosarcoma occurs more frequently in the small than in the large intestines, the ratio being approximately 2 to 1. The most common

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location in the intestinal tract is the ileum. The caecum, jejunum, and rectum, respectively, follow in order of frequency.

(2) The tumor is found most frequently in the first, third, and fourth decades of life. The average age incidence in the authors' series was 33.19 years.

(3) Males show a greater predisposition for the disease than females in the ratio of 5 to 2.

(4) The tumor occurs most frequently in the white race, but occasionally is noted in Negroes.

(5) The etiology of the tumor remains obscure. The rôle of trauma, antecedent or intercurrent disease, and inflammation or irritation of a chemical or bacterial nature in the production of this tumor has not been definitely established.

(6) The disease is not accompanied by a characteristic clinical syndrome. In most cases, the predominant symptoms are those of an acute or chronic intestinal obstruction. A correct pre-operative diagnosis is seldom made because of the extreme difficulty in differentiating this condition from other intra-abdominal diseases.

(7) Lymphosarcoma in the intestines may appear as an annular or polypoid growth. The former is the more common form. The tumor begins in the lymphoid tissue of the submucosa and spreads laterally through the coats of the intestines. It gradually invades and destroys the muscular coats to appear as a subserous tumor of rather firm consistency. The tumor rarely penetrates the serosa, but frequently causes an ulceration of the mucosa covering the tumor.

(8) It is almost the universal opinion that there is a decided tendency to aneurismal dilatation of the lumen of the involved gut in most cases, and that stenosis of the involved intestinal segment is less common than dilatation. In our series, the incidence of these pathological phenomena was reversed, as indicated by the thirty-seven cases with stenosis and eighteen with dilatation. We feel that these figures do not express the true relative incidence of these pathological findings, since they are based on less than half the cases in our series. The variance may be explained by the fact that in the majority of cases complete pathological data were lacking.

(9) Intussusception occasionally may be associated with lymphosarcoma of the intestines, especially with the polypoid type of tumor.

(10) Lymphosarcoma of the intestines is accompanied by metastases in some form or other, in practically every case. In the majority of cases, involvement of the mesenteric nodes of the affected intestinal segment by way of the lymphatics occurs. In a smaller number of cases, metastases occur in other parts of the body, especially the kidneys, liver, spleen, and ovaries, by way of the blood-stream.

(11) Adhesions of the tumor mass to other intra-abdominal organs is a relatively frequent occurrence, secondary abscess formation of the lymph-

nodes in the mesentery of the involved gut, such as occurred in our own case, is rare.

(12) The proper treatment of lymphosarcoma of the intestines is directly dependent upon an early diagnosis and the institution of prompt surgical measures.

(13) From a curative standpoint, surgery in the form of a radical resection of the involved gut and its mesentery offers the most, especially when the tumor is localized, and the lymphatic involvement is not too extensive. From a palliative standpoint, a side-tracking operation is indicated, especially when the growth is so extensive as to render a resection impractical or an extreme risk.

(14) Radiation should be employed in every case; in the inoperable cases, to control the growth of the tumor and to prolong life; and in the operable cases, to prevent recurrences and metastases.

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## COMPLICATIONS ASSOCIATED WITH MAJOR PROCTECTOMY\*

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MY PURPOSE in discussing this subject of complications associated with radical operations for carcinoma of the rectum, is to analyze the hazards that may be expected to occur in these operations when done in a general surgical service; and to emphasize the advantages of limiting these operations to members of the staff experienced in this type of surgery.

In reviewing the literature of the past ten years on this subject of surgery of carcinoma of the rectum, one is immediately impressed by the fact that major emphasis is placed upon the operative mortality and the late results in these operations. This is quite as it should be, for these are the two outstanding considerations, for on the one hand there is a marked difference in the mortality rate of the several procedures, and a distinct difference in the life expectancy, if one combines the figures of the most experienced surgeons reporting their results. I have been disappointed in reading these reports, to find how meagre is the discussion and analysis of the complications of these operations, which, of course, contribute so definitely either to the mortality or to the prolonged convalescence of these procedures.

Thus, in the symposium on cancer of the rectum reported in the British Medical Journal in 1920,<sup>1</sup> are included Miles' great contribution and full discussion by Grey-Turner, Lockhardt-Mummery, Gordon-Watson, and Uilkie, all authorities in this field. But in none of these discussions is there any analysis of the complications. The same is true of the latest papers by Miles,<sup>2</sup> by Jones,<sup>3</sup> by Rankin,<sup>4</sup> by Coffey,<sup>5</sup> and by Schmieden<sup>6</sup> that have appeared since 1927.

During the past seventeen years, the period of our follow-up system at the Presbyterian Hospital, we have had two hundred patients admitted with a proven diagnosis of carcinoma of the rectum. The analysis of this series, especially with regard to the operability, the type of operation, the technic used by several of the surgeons, and the late follow-up results with the various procedures, is too large a subject to discuss in a short paper.

In 1925 we organized our Proctology Clinic under Doctor Janssen's supervision, along lines conducive to the accurate study of rectal disease, especially neoplastic, and since then the study of the pathological material and the operative results have steadily improved, so that at present the rationale and procedures in these cases are far better understood and carried out than

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during the preceding ten-year period. But the study of the complications covers the seventeen-year period and includes both private and ward cases.

A study of the various complications listed under the several procedures brings out strikingly the differences in morbidity in major operations on this part of the intestinal tract, as compared with those on the stomach and duodenum, biliary tract and spleen, notably in the high incidence of urological complications and the low incidence of associated pulmonary disasters. This outstanding difference is limited to the cases where the operations have been carried into the pelvis. This will be discussed in more detail, both as to etiology and therapy. The other three major complications, ileus, haemorrhage and sepsis, will be considered at greater length than the other less frequent and scattered complications.

Infection of the urinary tract and its immediate and late sequelæ may be considered the most common complication. If urine cultures and microscopical sediment examinations are used as the criteria—and no doubt they are the only accurate tests—the incidence of cystitis would be more nearly 100 per cent. in the radical operations. We have based our incidence on the presence of pus in the urinalysis reports and the need for treatment of cystitis or associated urinary complications.

The only accurate studies on the incidence of urinary infection associated with proctectomy that I have been able to find are those of Cuthbert Dukes,<sup>7</sup> of St. Mark's Hospital, London. In a series of fifty cases, accurate daily microscopical studies of the urine were made during the post-operative course in the hospital. These examinations, quantitative in character, based upon the standard of 0-10 leucocytes normal, 10-100 excessive, 100 plus leucocytes in clumps indicating pus, brought out the disconcerting fact that a cystitis developed within a few days of the proctectomy in all fourteen female patients, and in the first fourteen males where an indwelling catheter was used with a wooden stopper. A modified catheterization method with anti-septic irrigation reduced this incidence in males from 100 per cent. to 60 per cent. The following sequence of events occurred in every one of the first twenty-eight cases. All were catheterized. The urine remained sterile until the second or third day, when staphylococci appeared in cultures. During the first five days the urine cell count showed either an excess of leucocytes or else a trace of pus, and then, rather abruptly, from the sixth to the eighth day after operation pus, became abundant, the cell count rising from 100 to 1,000 or over, per cubic centimetre. Pyuria usually persisted for the remainder of the patient's stay in the hospital (five to eight weeks) but in some cases it subsided within four weeks.

In our cases of radical operation, frank urological complications occurred in half of the cases. In the fifty abdomino-perineal operations, nine patients died before cystitis could be noted. In twelve there was no evidence of cystitis, nor any record of a catheter being used. In five patients, three males and two females, catheterization was not followed by cystitis. In the remain-

ing twenty-four cases, all catheterized, cystitis was a definite complication, requiring treatment. Our observation regarding the time of onset of cystitis after catheterization corresponds with Dukes' statement.

In the discussion as to the cause of these bladder infections, Doctor Dukes and Mr. Lockhart-Mummery,<sup>7</sup> who commented on his paper, attribute the cystitis to the introduction of bacteria along the catheter into a traumatized bladder containing residual urine, and a bladder whose normal supports have been largely removed. There is another factor not mentioned by any of the surgeons discussing this subject, save Daniel F. Jones,<sup>8</sup> who suggests it as a possibility—and that is the complete destruction of the nerve supply to the bladder. According to all the recognized authorities such as Quain, Testut and Jacobs, and Spalteholz, the nerve supply is as follows:

The visceral branches of the fourth sacral nerve are directed forwards to the lower part of the bladder, and communicate freely with branches from the sympathetic nerve. These branches are associated with others proceeding from the third sacral nerve, and they are sometimes derived mainly from the latter nerve. Sometimes filaments are added from the second sacral nerve.

The lumbar sympathetic motor fibres to the bladder pass by the aortic plexus to the inferior mesenteric ganglion, and thence through the hypogastric and pelvic plexuses, to supply the circular muscle, including the sphincter. Associated with these there are probably inhibitory fibres of the longitudinal muscle.

*Pelvic plexus.*—The pelvic or inferior hypogastric plexuses, one on each side, are placed in the lower part of the pelvic cavity by the side of the rectum, and of the vagina in the female. The nerves, continued from the hypogastric plexus, enter into repeated communications as they descend, and form at the points of connection small knots, which contain a little ganglionic matter. After descending some way, they become united with branches of the spinal nerves, as well as with a few offsets of the sacral ganglia, and the union of all constitutes the pelvic plexus.

From the plexus so constituted, numerous nerves are distributed to the pelvic viscera. They correspond in great measure with the branches of the internal iliac artery, and vary with the sex; thus, besides haemorrhoidal and vesical nerves, which are common to both sexes, there are nerves special to each—namely, in the male for the prostate, vesicula seminalis, and vas deferens; in the female for the vagina, uterus, ovary, and Fallopian tube.

The nerves distributed to the urinary bladder and the vagina contain a larger proportion of spinal fibres than those furnished to the other pelvic viscera.

*Vesical plexus.*—The nerves of the urinary bladder are very numerous. They are directed from the lower part of the pelvic plexus to the side and lower part of the bladder. At first these nerves accompany the vesical blood-vessels, but afterwards they leave the vessels and subdivide into minute branches before perforating the muscular coat of the organ. The lower part

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of the ureter is also supplied by these nerves; and secondary plexuses are given in the male to the vas deferens and the vesicula seminalis.

It is evident from the photograph of the dissection of the nerve supply taken from Spalteholz<sup>9</sup> that in the blind and blunt dissection of the rectum in the pelvis, and in its separation from the bladder, prostate, and seminal vesicles, and from the uterus and vagina in the female, the nerve supply as distributed by the pelvic plexus to the bladder is demolished. This leaves the bladder damaged and atonic, favoring residual collections of urine. It is well known that catheterization of the healthy tonic bladder seldom causes cystitis, but in the atonic distended bladder, catheterization, with the strictest aseptic precautions, is, as a rule, followed by a cystitis.

Given these predisposing factors, which of them can be eliminated or reduced to a minimum? Certainly the trauma to the nerve supply cannot be avoided in an adequate proctectomy. Whether or not the bladder should always be catheterized after a proctectomy is questioned by some surgeons on the ground that the introduction of a catheter certainly means infection, and that if left alone the bladder will spill over and gradually regain its tone. Thus, Davis,<sup>10</sup> and David,<sup>11</sup> of the Presbyterian Clinic in Chicago, avoid catheterization unless the patient shows marked retention, and David<sup>11</sup> does not use spinal anaesthesia because he believes it predisposes to retention. He states that over half of his patients require no catheterization.

On the other hand, there are definite reasons for catheterizing the patients before the beginning of the operation and maintaining an indwelling catheter for four or five days. The catheter outlines the urethra, preventing trauma to the bulbous urethra and facilitating the separation of the rectum from the urinary canal; it prevents distention of the bladder; makes it possible to measure the renal output, which is of great importance in the old and feeble cases; and provides great comfort to the patient. Jones,<sup>12</sup> of Boston, Rankin,<sup>13</sup> of Rochester, and Jones,<sup>14</sup> of Cleveland, employ the indwelling catheter with bladder irrigations. This is done also at the St. Mark's Hospital<sup>7</sup> in London. The infection of the catheter can certainly be reduced by the method proposed by Dukes, which provides for both sterilization of the catheter and bladder irrigation without repeated catheterization. The photograph of the apparatus explains the method now in use at the St. Mark's Hospital in London, as devised by Dukes. This will undoubtedly reduce the incidence of cystitis in the male, and to a lesser degree in the female patients, but there will always be the potential irritation and infection of a foreign body in the urethra, and a cystitis will inevitably occur in many cases.

It cannot be emphasized too strongly that the introduction of the indwelling catheter or of any catheter should be done by an experienced senior member of the interne staff, both in the male and female patients. This catheterization of the female cases cannot be entrusted to the rapidly rotating undergraduate nurse. The greatest attention should be paid to the cleansing of the meatus under direct vision.

The second, and in some ways the most serious, complication, especially in the one-stage abdomino-perineal proctectomy, is ileus. I am sure this has not been recognized as often as it should be, for the symptoms are not striking, and the true mechanical ileus is too often thought to be a paralytic ileus. Jones<sup>12</sup> of Boston, considers it the most frequent cause of his post-operative fatalities. It has occurred in eight of our abdomino-perineal cases, and in one of the perineal proctectomies. It is most often caused by the protrusion of a knuckle of small intestine through a break in the repaired pelvic peritoneum; secondly as a protrusion of gut around or to the outer side of the sigmoid colostomy, through the incompletely closed meso-sigmoid; thirdly, as an angulation ileus, due to plastic peritonitis in the repaired pelvis. Failure of the colostomy to function after it is opened, with persistent distention, is evidence of ileus, and unless the distention is promptly relieved by enemas and stupes and pituitrin, the patient will go down hill rapidly. Operative interference is definitely indicated, and promptly, if conservative measures do not give definite and immediate relief. The patient should be taken to the operating room, and the repaired pelvic floor first examined from below, after removal of the packing, with the patient in the lithotomy position and with good light, to make sure a loop of small intestine is not protruding through the repaired pelvic peritoneum. In one of our recent cases this was done and the loop pushed back and the pelvis repacked. The patient made an uneventful recovery. Jones<sup>12</sup> states in a recent communication that ileostomy relieves a large proportion of the patients with this complication. In another of my own cases, with ileus developing on the fourth day, on finding no loop below I did an entero-enterostomy above, between collapsed and distended loops, and the obstruction was relieved; but after a few days the patient began losing weight and strength and died of inanition twenty-one days later. Autopsy showed the entero-enterostomy between jejunum and low ileum, with the intervening long segment of small gut herniated around the sigmoidostomy through an incompletely closed mesosigmoid.

The best treatment is, of course, preventive, and by careful attention to the smooth repair of the pelvic floor, the closure of the mesosigmoid to the pelvic and lateral pelvic peritoneum, this complication will be reduced. From this standpoint alone, as well as others of which time and the scope of this paper do not permit a detailed discussion, Coffey's<sup>5</sup> two-stage abdomino-perineal operation with the rubber-covered multiple gauze wick drain brought up extra-peritoneally between bladder or uterus and peritoneum favors a more adequate and secure closure of the pelvic peritoneum. This method provides for the closure over a supporting tampon in place during the suturing of the pelvic peritoneum, and without the immediate disturbance of the perineal stage of the removal of the rectum and the hurried and more-or-less blind placing of the pelvic pack.

Post-operative haemorrhage is always a serious complication in patients that have undergone such severe operations. The operation at best results in a considerable loss of blood, demanding a transfusion, as a rule, at the close

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of the procedure. Post-operative haemorrhage occurred in five of the abdomino-perineal operations, in one of the abdomino-perineal with preservation of the sphincter, and in one perineal proctectomy. In our experience secondary bleeding has occurred from the middle haemorrhoidal branches that had not been ligated, or from the branches of the lateral and middle sacral vessels, as they enter or emerge from the sacral foramina. The latter group of vessels are easily traumatized in the perineal dissection, particularly if the stripping of the contents of the hollow of the sacrum is carried too close to the bone with removal of the parietal pelvic fascia.<sup>15, 16</sup> We feel that the middle haemorrhoidal vessels should be ligated during the abdominal stage of the combined operation, and not overlooked in the perineal route.

Sepsis and peritonitis are not the dreaded complications that they used to be, because of the better preparation of patients, the more extensive excisions, with the parts in view, and the wide, open drainage. Adequate drainage of the cellular tissues is essential. I know of no more virulent infection than that which takes place in the damaged retroperitoneal pelvic cellular spaces, if drainage is not provided. I cannot understand why Lockhart-Mummery<sup>17</sup> in closing the perineal wound without drainage, after inverting the lower end of the sigmoid or pelvic colon, does not have serious infection of the pelvic cellular spaces. For this reason, Coffey's use of extensive retroperitoneal gauze wicks coming up between bladder and peritoneum, or uterus and peritoneum explains his improved results in the abdomino-perineal operation.

The mortality in such major operations as the abdomino-perineal, when done by several operators on a general surgical service, is uniformly high—well over 30 per cent., judging from figures from several well-known clinics. It has been clearly demonstrated by Miles and Jones that the individual surgeon, doing many of these cases with the advantages of acquired technic and cumulative experience in judging the most favorable operative procedure for the individual patient, can reduce the mortality to below 10 per cent. In any general surgical service, this type of surgery should be done by two of the surgeons interested in the subject and each able to do the several operations with the other assisting. Team-work is essential in the pre-operative, operative and post-operative care of these causes. Unless there is team-work, and unless the operations are done by surgeons experienced in this work, the mortality will be prohibitive.

In the Presbyterian Clinic since 1925, as a result of such team-work and of limiting the operations to surgeons with experience in this field, the operative mortality has been reduced from 40 per cent. to 17 per cent. We attribute this largely to the improved selection of the operation, the most suitable for the individual patient, and to the type of lesion; to the better pre-operative preparation of the colon; to the better care of the urinary tract; to the better selection of anaesthesia—spinal and gas-oxygen; to the shortening of the operative procedure, as a result of more expert assistance; and finally to a better appreciation of the complications, both in preventing them and in appreciating such conditions as ileus and haemorrhage in the early stage.

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TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY

STATED MEETING HELD JANUARY 13, 1932

The President, DR. JOHN R. DOUGLAS, in the Chair

RECURRENT ADAMANTINOMA OF THE JAW

DR. BRADLEY L. COLEY presented a woman, aged fifty-four, who was admitted to Lincoln Hospital April 14, 1931, complaining of two large tumor masses on the right side of the face. (Fig. 1.) Thirty-nine years ago the patient first noticed a slowly growing tumor in lower right parotid and submaxillary areas. The mass was never painful. It was always hard and seemed attached to bone. At first it was pea-sized. In 1907 an operation was performed at the Presbyterian Hospital by Dr. Ellsworth Eliot for cyst of the mandible, which recurred in a year. He operated again for the same condition in 1910 and a second recurrence followed. Nine years ago she went to the Fourth Surgical Division of Bellevue Hospital for radium-seed implantations by Dr. Harold B. Keyes, who asked Doctor Coley to see her in consultation. Previous to that time she had severe frontal headaches and occasional colds. Growth was very slow at first and the patient was rather unconcerned until one year ago, when her lower right teeth began to ache. Five teeth were extracted by merely pulling them out with the fingers. Following this the mass began to grow rapidly, but it was never painful or red. Nine years ago she noticed a little nodule over her right temporal region. This also was painless and small and did not worry her until two years ago, when growth became exceedingly rapid, but painless. Patient has been in excellent health; has not lost weight recently, nor has her appetite suffered. She had had the usual diseases of childhood. Gave no history of trauma to the jaw or teeth. Examination elicited nothing of interest aside from the local condition. In the right mandibular region there was a large, firm, non-tender, slightly cystic mass, which appeared to arise from the bone. There was a second mass, distinct and separate from the first, located in the temporal region of the same side. There was limitation of jaw movements and especially restriction in degree to which the mouth could be opened. Intra-oral examination showed a bulky tumor occupying the right



FIG. 1.—Before operation. April 15, 1931.

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alveolar region. It was fungating through mucosa in several places. The neck was the site of two linear scars of the previous operations. There was no adenopathy. Wassermann was negative.

*X-ray findings.*—April 14, 1931.—Marked swelling of the right lower jaw with large bone defect. Greater part of the horizontal and ascending ramus absent. Bone defect in the right parietal region.

*Operation.*—April 16, 1931. Anæsthesia: gas, oxygen, and ether. *A.*—A curved incision over tumor was carried down to cyst wall. Cyst then exposed down to bony attachments, peripherally. Cyst then exposed and trimmed off, leaving deep bone portion from which pale, yellowish-gray, shiny tumor tissue was removed. Entire cavity was packed with Chlumski during the second stage of the operation.

*B.*—Long, curved incision in the hairline, exposing cyst of right temporal region. The greater portion of the cyst wall was excised. The deeper portion, however, together with considerable amount of solid tumor tissue was peeled from the depression in the temporal fossa and removed in one piece. The actual cautery was used to control bleeding. The cavity was packed with gauze soaked in Chlumski during closure of the jaw incision. Both incisions were then closed with black silk and Michel clips. Pipe-cleaner drain was placed in jaw incision and a wick of iodoform packing in temporal incision. The following day the patient was in poor condition and was given a transfusion of 350 cubic centimetres of whole blood by the Lindeman method, using the husband as donor.

In addition, hypodermoclyses of glucose and saline were required to administer sufficient fluids for the first four days. She was discharged with both wounds practically healed on the fifteenth post-operative day.

It was apparent that the tumor which was present in the right mandibular region was not completely removed and the patient was advised to re-enter the hospital for a radical procedure, including resection of the involved area of the mandible. Two months later she re-entered Lincoln Hospital (July 10, 1931) for this purpose. At this time there was no apparent recurrence of the temporal mass, but there was evidence of tumor tissue in the jaw which was apparent upon external and intra-oral examination.

Examination at this time showed a large depression the size of half an orange (small) in the right temporal region which represented the site of excision of the tumor two months previously. The hard, bony mass attached to the lower jaw presented much the same appearance as when she left the hospital. The mucous membrane was ulcerated at two small points, from which rather foul fluid could be gently expressed.

*Second operation.*—July 14, 1931. Under oil-ether colonic anæsthesia. Pre-operative diagnosis: solid and cystic adamantinoma of the right side of the mandible. Considerable of the right half of the mandible had been excised at a previous operation done some twenty years ago. There was now a large, solid and cystic recurrence which extended beyond the mid-line as far as the left central incisor tooth. It was closely adherent to the skin in one place and quite adherent to the mucosa throughout most of its extent.

*Procedure.*—Incision just to the left of mid-line of chin vertically downward and curving to the right and ending at a point opposite normal angle of jaw. Incision carried down to mandible. Periosteum elevated and jaw divided at this spot with Gigli saw. The right portion, including tumor, was freed from underlying mucosa and, in the main, from overlying skin and the entire tumor removed. Mucosa approximated with silk. Skin flap brought back and sutured with silk. Two rubber drains were used and dead space obliterated with voluminous gauze dressings applied with uniform pressure.

The patient was in mild shock the afternoon of the operation and was transfused with improvement of general condition. Hypodermoclyses of glucose and saline were again used for a period of three days, during which time it was difficult for the patient to take fluids by mouth. She objected to nasal catheter feedings. On the third day the

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drains were shortened and there was marked sero-sanguinous discharge which gradually lessened in amount. One week after the operation it was noted that there was a slight discharge of saliva from the lower angle of the wound, the lip having healed nicely without wound infection. This slight discharge of saliva diminished and the patient was discharged on the eleventh post-operative day with a very minute amount of drainage. This finally ceased and the wound has remained completely healed.

The patient's present condition (Fig. 2) presents a most difficult problem from the standpoint of dental prosthesis. There is very little to work with and it has been a



FIG. 2.—After operation. December 21, 1931.

difficult task to provide her with a useful denture which, at the same time, improves her appearance. This has been accomplished by her dentist, Dr. Sidney Leistner.

*Pathological report.*—April 23, 1931.—Slides reveal numerous larger and smaller rounded-cell islands, isolated and confluent, embedded in dense hyalinized fibrous tissue. (Fig. 3.) The cell groups tend toward alveolar or cystic formation, arranged circularly about a central cavity. A distinct basement membrane is visible surrounding the cell masses, which resemble stratified cuboidal epithelium of three to four layers of thickness. Those nuclei nearest the basement membrane tend toward columnar form; the others are small and rounded, containing much chromatin. Cytoplasmic outlines are obscure. Spines are not visible. The cells resemble the basement cells of the Malpighian layers

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of the epidermis. In other areas cell groups are confluent and form solid sheets of cells.  
*Diagnosis*.—Adamantinoma of the jaw.

Section taken months later resembles previous sections, although there are fewer islands, the cells forming dense and compact masses. Here and there between these massed cells occur peculiar rounded alveoli consisting of columnar cells resting on a basement membrane and surrounding capillaries whose walls are greatly thickened. Between the cell groups the stroma is dense and contains numerous foci of lymphocytes surrounding small capillaries. *Diagnosis*.—Adamantinoma of the jaw.

This case is of interest particularly because of the unusual duration of the tumor, which all told has been present for almost forty years. Its extremely slow rate of growth and relatively benign nature are apparent from the fact that the first operation for this condition was undertaken twenty-one years ago and that, although the patient states that a recurrence was prompt fol-

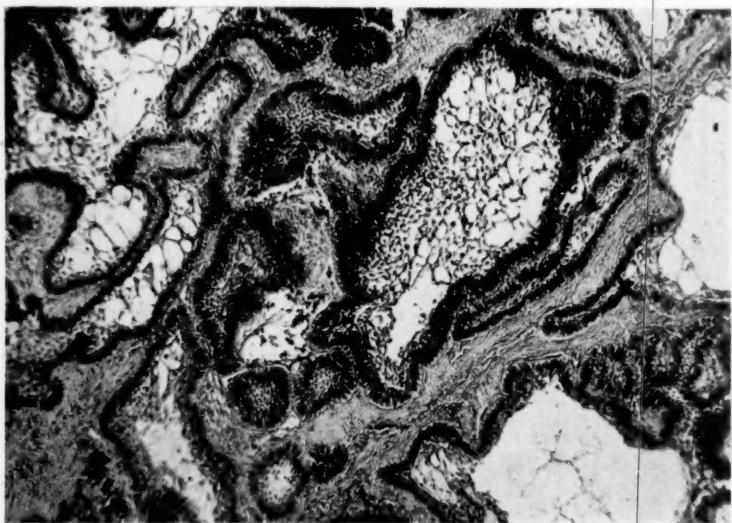


FIG. 3.—Recurrent adamantinoma. Microphoto of tumor. April 16, 1931.

lowing this operation and also the one done three years later, she had suffered very little inconvenience during the greater part of this long period.

In this case the tumor was no longer confined solely to the bone and, for this reason, it is extremely difficult to be at all confident that recurrence will not take place from some small soft part area that was unrecognized. Carter\* in a recent issue of the *ANNALS OF SURGERY* reports three cases of adamantinoma of the lower jaw together with radiographs and photographs. His cases were all in women and in all three the tumors apparently began following the extraction of a tooth. Trauma, infection or continued irritation is said to be the stimulus necessary to start the growth of parodontal epithelial débris. The slow growth of these tumors is borne out by Carter's cases, in two of which the tumor had been present for twelve years and in the third case for eleven years. Metastasis did not occur in any of his cases. He

\* *ANNALS OF SURGERY*, vol. xciv, p. 1, July, 1931.

## DISARTICULATION AT THE HIP-JOINT

refers, however, to Ewing as having seen metastasis to the cervical glands on two occasions, and also to Simmons' twelve cases, in two of which there was late metastasis to the cervical glands.

All three of Carter's cases developed local recurrence following one or more conservative operations and with each recurrence the tumors re-appeared more promptly and grew more rapidly. Carter favors radical resection of the jaw as the method of choice. All his patients have remained well following this procedure. He mentions the advisability of transfusion and the advantage of nasal tube feeding during convalescence.

## DISARTICULATION AT THE HIP-JOINT FOR CHONDROMYXOSARCOMA OF THE FEMUR

DR. BRADLEY L. COLEY presented a man, forty-eight years of age, who in August, 1928, began to feel a tingling sensation in the right thigh. This was followed in four



FIG. 4.—X-ray of right thigh (showing tumor).

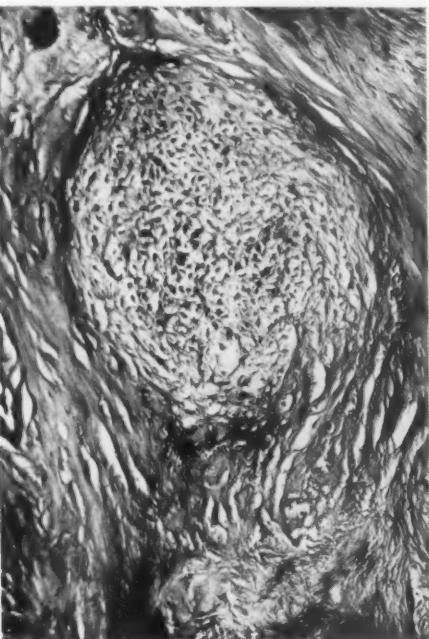


FIG. 5.—Microphoto of tumor (chondromyxosarcoma).

months by swelling and pain. A diagnosis of osteomyelitis was made at St. John's Hospital, Far Rockaway; drainage was instituted in November, 1928, and the operation repeated in June, 1929. A report from the hospital in August, 1929, states that microscopic examination of the tissue removed showed it to be osteochondroma with malignant changes. A second letter stated that the pathological findings were "inflammatory reaction in soft tissues and necrosis of bone." He was referred to the Memorial Hospital in August, 1929.

*Physical examination.*—August 21, 1929, showed on the lateral aspect of the right thigh two linear incisions, both healed and presenting a combined length of nine inches. There was no definite palpable tumor beneath these scars. Posterior to the more lateral of the two scars there was a slight sense of deep swelling, ill-defined, and presenting no bone irregularities and no definite line of demarcation. Motions at the hip were not

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limited. There was no swelling, redness or other changes in the skin of the soft parts and there was no enlargement of the lymph nodes in the groin.

The urine examination was negative. Blood examination revealed a slight secondary anaemia and relative lymphocytosis with a normal total white blood cells.

X-ray films (Fig. 4) were obtained which were reported as showing evidence of a definite and well-developed attempt at repair with callus production along and in the cortex of the outer surface of the upper third of the shaft of the femur. The films lacked the essential features of a neoplastic process.

He was given one exposure of high voltage X-ray and kept under observation and

later referred to the Hospital for Ruptured and Crippled as a case of chronic inflammatory disease of the femur. In March, 1930, an exploratory osteotomy was performed because of persistent pain and a histological diagnosis of osteitis fibrosa was made. The wound healed and pain was relieved. A second osteotomy was performed in October, 1930, because of return of pain and, at this time, a large cyst-like cavity filled with soft tumor tissue was exposed and carefully curetted. The pathological report was chondromyxosarcoma.

Amputation was now advised, but declined by the patient until January 30, 1931, when a hip-joint disarticulation, using a tourniquet and Wyeth pins, was performed at Memorial Hospital. He was given a transfusion of 600 cubic centimetres of blood immediately after the operation, which was followed by uneventful recovery and primary wound healing. Coley's toxins were administered during convalescence. He was discharged on the twenty-fourth post-operative day. He is now able to get about on crutches. Although he has been fitted with an artificial limb he has not found it satisfactory.

*Pathological report.*—Dr. Fred Stewart. *Gross.*—Specimen is that of upper end of the femur. In the region of the greater trochanter there is a marked swelling 5 by 6 by about 2.5 centimetres, cystic in areas, and in others more or less firm and crepitating. On section in the area of the greater trochanter there is replacement by a polycystic tumor mass filled with gelatinous-like material with here and there slight spicules of what appears to be calcifying areas of cartilage. There is thickening of the cortex above the greater trochanter about 3 centimetres in length, but below this there is considerable destruction of the cortex with infiltration of the medullary cavity which extends down to a level 13 centimetres below the greater trochanter. The cortex is eroded along the shaft by this medullary infiltrating tumor mass, and just below it there is marked thickening of the cortex by osteoid bone in an attempt to seal off this tumor invasion. The tumor tissue within the medullary cavity has the appearance and consistence of cartilage in a precalcified state. Just below and opposite the greater trochanter in the inner side of the cortex for a distance of 6 centimetres is a layer of peculiar fibrous and osteoid tissue. (Fig. 5.) This is probably due to the extent



FIG. 6.—Post-operative scar (right side). Operation, January 30, 1931.

placement by a polycystic tumor mass filled with gelatinous-like material with here and there slight spicules of what appears to be calcifying areas of cartilage. There is thickening of the cortex above the greater trochanter about 3 centimetres in length, but below this there is considerable destruction of the cortex with infiltration of the medullary cavity which extends down to a level 13 centimetres below the greater trochanter. The cortex is eroded along the shaft by this medullary infiltrating tumor mass, and just below it there is marked thickening of the cortex by osteoid bone in an attempt to seal off this tumor invasion. The tumor tissue within the medullary cavity has the appearance and consistence of cartilage in a precalcified state. Just below and opposite the greater trochanter in the inner side of the cortex for a distance of 6 centimetres is a layer of peculiar fibrous and osteoid tissue. (Fig. 5.) This is probably due to the extent

## TRAUMATIC RUPTURE OF SPLEEN

of tumor along the shaft with decalcification leaving in many places only the fibrous framework of the cortex. Below the greater trochanter on the same side the shaft is probably destroyed for a distance of 6 centimetres in a localized area. *Impression.*—Chondromyxosarcoma arising on the basis of an enchondroma near the old epiphyseal line of the greater trochanter. Prognosis good.

This case illustrates the difficulties that are occasionally encountered in obtaining a correct diagnosis, not only by clinical and röntgenographical examination, but even after repeated biopsies. Yet after four previous surgical interventions there is no evidence of pulmonary metastasis three years after the first exploration and eleven and one-half months after the hip-joint disarticulation. (Fig. 6.)

An accurate röntgenographical diagnosis has not been possible in at least 20 per cent. of all cases of suspected bone tumor. The dangers of error in diagnosis from biopsy lie in the failure of the surgeon to obtain characteristic tissue. The conflicting histological reports on the material obtained from the earlier biopsies in this case must be explained on this ground. In a slowly growing central sarcoma there is often a peripheral zone which shows reactive bone changes. Unless ample material is obtained an incorrect diagnosis may be made.

## TRAUMATIC RUPTURE OF SPLEEN—SPLENECTOMY AND AUTOTRANSFUSION

DR. BRADLEY L. COLEY presented a boy, sixteen years of age, who was admitted to Lincoln Hospital December 3, 1929, with a history of having coasted into a lamppost while on a sled about five hours prior to admission. At the time of the accident he complained of pain in the right shoulder and was treated in the emergency room, where a dislocation was reduced and the patient sent home. At home he began complaining of pain in the upper abdomen, extreme weakness and thirst. The family physician was called in to see the patient and gave him 1/6 grain of morphine and sent him to the hospital.

On admission he was found to be in mild shock, of ashen gray color, cold and clammy. Pupils were in mid-dilatation and reacted to light. Heart rate of 90; sounds of fair quality. Lungs clear. No evidence of fractured ribs. The abdomen was distended. There was a sense of resistance and tenderness in the left upper quadrant. No obliteration of liver dullness. Rectal examination was negative. Blood-pressure 94/48. Temperature 98°. Haemoglobin 55 per cent. (Dare method); red blood cells, 3,400,000; white blood cells, 18,000; polymorphonuclears 84 per cent.; lymphocytes 10 per cent.; endotheliocytes 6 per cent. Urine clear; specific gravity 1035; acid; sugar, 0; acetone, 0; albumin, 0; microscopic: negative.

A hypodermoclysis of 1,000 cubic centimetres of 5 per cent. glucose was given and the patient was taken to the operating room, with a diagnosis of traumatic rupture of spleen. Splenectomy and autotransfusion under ether anesthesia.

The abdomen was distended with blood estimated at about 1 litre. The intestines were collapsed. The spleen presented a large tear on the convex surface opposite the hilum. Blood was bailed out and preserved for autotransfusion. Spleen was then delivered; the pedicle clamped, spleen removed and the pedicle ligated with No. 1 chromic catgut. The abdominal wall was then closed in layers without drainage.

Autotransfusion was commenced at the time the pedicle of the spleen was being ligated and continued during the closure of the abdominal wall. This was rendered

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necessary by the extremely critical condition of the patient whose pulse became imperceptible. In the opinion of the anæsthetist, he was about to collapse. Fifteen hundred cubic centimetres of a mixture of the patient's blood and saline (1:2) were given, so that he received 500 cubic centimetres of blood and 1000 cubic centimetres of saline. Meanwhile a donor was obtained so that shortly after the operation he received a transfusion of 350 cubic centimetres of whole blood. The following day another transfusion was given, using 350 cubic centimetres of blood.

The patient made an uneventful recovery except for an acute follicular tonsillitis. He was discharged with wound healed December 24, 1929.

The patient was re-admitted May 14, 1931, with a mild influenzal infection from which he made an uneventful recovery. His abdominal wound was firmly healed. At this time the following laboratory data were obtained: Blood sugar, .087. Blood urea nitrogen, 18.0. Wassermann, negative. White blood cells 26, 500; polymorphonuclears 70 per cent; lymphocytes 30 per cent. *Platelet count: 184, 000.*

On December 7, 1931, an examination of the blood showed: Red blood cells 4, 200, 000; white blood cells 7, 900; haemoglobin 86 per cent.; polymorphonuclears 46 per cent.; lymphocytes 54 per cent. *Platelet count: 310, 000.*

This case was shown to illustrate the value of autotransfusion in cases of massive haemorrhage into the abdominal cavity. A similar case was presented by Doctor Coley before the Surgical Section of the Academy of Medicine November 24, 1927.

The earlier case was a male of thirty-six who was admitted to the Second Surgical Division of Bellevue Hospital with a history of having fallen a distance of six feet, striking his left side across a wooden brace. Although a diagnosis of ruptured spleen was made on admission, the patient would not consent to immediate operation and it was five hours from the time of injury before operation was finally performed. His blood-pressure fell the first two hours after admission to 65/47. At operation a ruptured spleen was removed and 750 cubic centimetres of blood, which was strained through gauze, was obtained from the unclotted blood in the peritoneal cavity and transfused directly into the right cubital vein by an assistant. The transfusion progressed simultaneously with the closure of the abdomen and was followed by the administration of an additional 300 cubic centimetres of normal saline solution.

This patient made an uneventful recovery, leaving the hospital on the fifteenth post-operative day with the wound healed by primary union, and was presented some fifteen months after the accident without symptoms and engaged in his former occupation of ironworker.

Hamilton Bailey has classified cases of ruptured spleen in four groups: (1)—The patient rapidly succumbs, never rallying from the initial shock. (2)—Initial shock—recovery from shock. Signs of ruptured spleen. (3)—The signs of an intra-abdominal catastrophe are delayed. (4)—Spontaneous recovery. The case now presented apparently belongs in Group 3 of Bailey's classification.

DR. WILLY MEYER said that several years ago, in summer, during a severe heat wave, he was called to see a boy who had been injured in the street by an automobile. The boy had been struck in the side and the diag-

## ACTINOMYCOSIS OF KNEE

nosis of rupture of the spleen was made. After operation everything went well, but he developed, at the same time with two other operative cases, an elevation of temperature to between  $106^{\circ}$  and  $107^{\circ}$ . This was found not to be a reaction from the wound but due to the tremendous heat prevailing at that time. The cases all recovered.

DR. RUSSEL H. PATTERSON said that he had done two autotransfusions. One patient had a haemothorax following fractured ribs. There was so much respiratory and cardiac embarrassment that aspiration of the blood was necessary. The patient was very anaemic. The blood was filtered through gauze into a basin and with a needle in the vein syringes full of the blood were given to the patient until he had received about 700 cubic centimetres of his own blood. The second patient was a case of ectopic pregnancy. The woman had lost a lot of blood and was marble white. The donor did not arrive quickly enough so 800 cubic centimetres of blood was removed from the pelvis during the laparotomy. The blood was removed with a cup and strained through gauze into a basin and was then given back to the patient in one of the veins of the arm by means of a syringe and cannula. Both these cases recovered without any harm and apparently with much benefit from the autotransfusions.

DOCTOR COLEY, in closing the discussion, said that the beneficial effects in the previous case of ruptured spleen in which he had done autotransfusion had caused him to prepare for this procedure before operation was done. All the blood was strained through gauze and to it was added warm, normal saline solution, care being taken not to have it above blood heat. Two men were working simultaneously and it took less than ten minutes to get in the 1,500 cubic centimetres of blood and saline solution.

## ACTINOMYCOSIS OF KNEE

DR. CHARLES E. FARR presented a boy, four years old, who entered St. Mary's Hospital for Children May 8, 1931, on account of a swollen right knee with many discharging sinuses.

Six months before admission the boy, while playing in the house, fell, striking his right knee. The following day the knee was swollen. The child was taken to various clinics, X-rays were taken which were pronounced negative and finally the joint was aspirated four times on different occasions. As this was unsuccessful, no fluid being obtained, further X-rays were taken and again pronounced negative. As a last step the knee was incised on three different visits and finally pus was obtained. An X-ray taken two months ago was again negative. The knee continued to discharge profusely. The family physician noted in the discharge a number of yellow granules.

The right knee was greatly swollen, red and moderately tender. There were a number of discharging sinuses and a profuse growth of exuberant unhealthy granulations. Yellow amorphous material appeared in one sinus and was sent to the laboratory for search as to sulphur bodies. There was marked spasm of the knee. The femoral nodes were greatly enlarged but not tender. (Fig. 7.)

The boy ran a septic temperature, as high as  $104^{\circ}$  F. This was partly relieved by an operation for drainage May 12. The knee-joint was found wide open and full of pus and débris but without involvement of bone or cartilage. Many large tumor-like masses

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were found about the joint and in the various sinuses. A handful were removed for study. The clinical findings were of no great aid. There was a moderate secondary anaemia; 3,520,000 red blood cells; and 70 per cent. haemoglobin. The leucocyte count ranged from 12,000 to 20,000, the polymorphonuclears from 75 per cent to 79 per cent. All other blood findings were normal. This included Wassermann blood tests on the child and the entire family. The urinalysis was normal. The blood culture was sterile. Nose and throat findings were normal. The intradermal tuberculin test was strongly positive on several occasions. Smears from the wounds showed many organisms, staphylococci, streptococci, a very few acid-fast organisms resembling tubercle bacilli and many actinomycetes. Cultures showed streptococcus haemolyticus and actinomycetes. These smears and cultures were repeated at the New York Hospital laboratories and the findings were identical. A number of X-rays of the knee and of the chest were reported



FIG. 7.—Limb amputated on account of actinomycosis of knee.



FIG. 8.—Face of section of the amputated portion seen in Fig. 7.

negative except for soft-part swelling and finally slight erosion of the lower epiphysis of the femur.

The treatment consisted of large doses of potassium iodide, cod-liver oil, ultra-violet rays, and finally X-ray. Whole blood transfusions were given May 12 and June 15. There was no improvement and the general condition of the boy became steadily worse. Locally there was an increase in the size of the knee, of the spasm and of the discharge. The femoral nodes were now very greatly enlarged, forming a mass 4 by 5 centimetres and 3 centimetres deep.

Microscopic examination of the tissues removed from the knee on May 12 revealed the following: Two roughly spherical masses each approximately 2 centimetres in all diameters. There is an apparent point of attachment on each but the rest of the surface is fairly smooth and covered by a thin, reddish membrane. On section the tissue is found to be spongy, chiefly reddish in color, but there are some whitish areas found. Microscopic sections were stained by the ordinary methods, also Mallory's for connective

## ACTINOMYCOSIS OF KNEE

tissue, Van Gieson, phosphotungstic acid, Gram, eosin methylene blue, and tubercle bacilli stain. The bulk of the specimen is composed of interlacing strands of connective tissue. These are more closely packed than is usually found in a granulomatous process. The strands are separated from one another by rather anaplastic spindle-shaped cells. Mitoses are found in small numbers. A few tubercle-like bodies are found in this but no tubercle bacilli have been found in these or elsewhere. There are a few small processes on the edge of the specimens where the tissue is rather necrotic. In one of these there are a few filaments which might well represent mycelium of a fungous form. These are stained with Gram but they are not recognized in the carbol fuchsin stained specimens. Streptococci and other bacteria are recognized. Without bacteriological study the pathologist was inclined to place the tissue in the general group of fibrosarcomas where it may well belong, but in view of the cultural studies and the findings noted above, the case seems to represent the reaction of tissue to a fungus infection. (Olcott.)

On May 27 at the New York Hospital a guinea-pig, No. 6464, was injected with 0.7 cubic centimetre suspension from the node near the knee. On June 24 0.3 cubic centimetre old tuberculin was injected. Animal killed July 17 (fifty-one days after inoculation). Autopsy shows many very fine haemorrhagic points in liver. Spleen moderately enlarged and nodular with many grayish nodules.

Microscopic section shows endothelial proliferation in the liver, and in the spleen fairly typical tubercles with endothelioid cell proliferation and very few giant cells. This would pass for tuberculosis were it not for the isolation of actinomycosis in the bacteriological laboratory. This makes it probable that the guinea-pig condition is also actinomycosis and that the lesions are similar.

Because of the evident failure of treatment a mid-thigh amputation was performed June 16, 1931, and a packet of nodes removed from Scarpa's triangle. This was considered only a palliative measure as the process certainly extended well above the line of amputation.

Recovery was rapid and healing progressed slowly but surely. The boy was discharged September 1, 1931, nearly healed and in excellent condition. He was re-admitted to the Medical Service in November suffering with a lobar pneumonia and again made a rapid recovery. X-rays of the chest at this time were quite suggestive of pulmonary tuberculosis. On January 11, 1932, a further X-ray study suggests but does not affirm hilar tuberculosis.

The final pathological reports are as follows:

June 16, 1931.—Femoral lymph node. Ovoid mass 3.3 by 2.3 by 2 centimetres. Capsule smooth, intact, semi-opaque and moderately injected. The tissue is firm but elastic. On section the capsule is about 1 millimetre in thickness. Under this is a row of small, irregularly spherical, brown masses, each about 3 millimetres in diameter. The central tissue is a lighter red with whitish strands running through it and converging at a point where the surface is somewhat indented and the brown masses are absent. Frozen section shows a few lymphocytes at the periphery. The bulk of the specimen consists of a structure which might be considered a fibroma if the history were not known. The paraffin sections with differential stain show smooth muscle in the lymph node. No tubercle bacilli or other organisms have been found.

June 19, 1931, paraffin sections show the same fibroma-like morphology with, in addition, some small areas which resemble the usual picture of tubercles. The cells rather less anaplastic than in the frozen section. Taken alone the picture would be considered a fibroma or fibrosarcoma. The difficulty is in establishing whether or not the fungus present in the preceding specimen might be considered as a secondary invader.

*Supplementary report, August 6, 1931.*—Tuberculous granuloma—lymph node and leg—atypical—pseudo-sarcomatous reaction. (Fig. 8.) Microscopically, there is a definite mass of tissue which resembles the tumor-like area—in a vessel. In another section there are quite definite tubercles. In some cases these are little more than single

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Langhans' giant cells; in others there are small masses of cells. In view of the guinea-pig finding (No. 6464) with its typical hyperplastic tubercles, there seems little doubt that the process represents tuberculosis. However, the pseudo-sarcomatous picture is extremely remarkable. It is possible that the absence of characteristic Van Gieson staining reaction is associated with an endothelial process rather than a myomatous. The fungus must be considered as a possible secondary invader. (Olcott.)

This case is reported because of the extreme difficulty in establishing a final diagnosis. It seems quite certain that the boy had actinomycosis. The possibility of tuberculosis is present, supported by the positive tuberculin test, the finding of rather doubtful acid-fast organisms in the wound secretion, of fairly typical tubercles in the original specimen in the femoral nodes, and of more doubtful ones in the inoculated guinea-pig.

Against tuberculosis are the facts that the acid-fast organisms were very few and atypical in appearance and staining, the inoculated guinea-pig did not die after being injected with tuberculin, and the child recovered after a manifestly inadequate operation, and later from an attack of pneumonia.

For sarcoma we have fairly typical gross and microscopic findings in the original growth and in the metastatic nodes.

The fact that the child is alive and well eight months after a very incomplete operation is strongly against the diagnosis of sarcoma.

Clinically the diagnosis remains actinomycosis of knee.

### CARCINOMA OF SIGMOID-COLON INTUSSUSCEPTION

DR. CHARLES E. FARR presented a man, sixty years of age, seen in consultation on January 26, 1930, with a history of intestinal obstipation and bleeding, intermittent, of about two years' duration. For two days there had been obstipation and bleeding from rectum. *Examination* showed a bleeding mass in rectum; distention of abdomen.

January 28, 1930.—When he was admitted in the hospital, all signs and symptoms had disappeared, but a barium enema showed about the middle of the sigmoid or just above the rectosigmoid junction a large, jagged, filling defect, either carcinoma or abscess. Proctoscopic and sigmoidoscopic examinations were made. A small pedunculated growth was seen at the rectosigmoid juncture. It was removed by electric snare February 4, 1930. The growth was 10 centimetres from the anus. *Microscopical examination*.—Adenomatous polyp.

August 10, 1930.—Well until now. Return of bleeding and obstipation. *Physical examination*.—Negative. Exploratory laparotomy was done under spinal anaesthesia. Tumor found in upper sigmoid, 4 centimetres in diameter and *inverted*. (Fig. 9.) A Mikulicz operation was performed without difficulty. Recovery was uneventful although the final closure of the fecal fistula was somewhat difficult. The man now appears in vigorous health and has no symptoms.

The case was presented because of the intussusception. This must have occurred intermittently for over two years. The tumor was easily felt during the attacks but disappeared in the intervals. Much valuable time was lost because of the failure to follow up the X-ray findings. The tumor was beyond the reach of the sigmoidoscope. The removal of a benign adenoma simply confused the picture further.

*Pathological report*.—The specimen consists of about 16 centimetres of large intestine, curved on itself as if it had been removed from the abdomen in a previous stage of the operation. The intestine is about 5 centimetres in diameter and the whole mass 12 by 10 by 10 centimetres in size. The serosa is cloudy. The lumen has been opened up. A papillary projection about 2.5 centimetres in both diameters and 0.6 centimetres

## CARCINOMA OF SIGMOID-COLON INTUSSUSCEPTION

in height was found on the mucosa of the outer border of the arch. Most of the surface of this was ulcerated. The process does not seem to extend far into the intestinal wall and there is little or no obstruction of the lumen of the intestine. Several paraffin sections made. One of these shows a characteristic area of gelatinous adeno-carcinoma. It seems to be small and to have invaded the tissues only just below the surface.



FIG. 9.—Carcinoma of sigmoid-colon intussusception.

Doctor Farr stated that this was the second intussusception of a carcinoma of the sigmoid he had treated. The other was promptly recognized and properly treated.

DR. ALLEN O. WHIPPLE said that a year ago he had the experience of operating on a case diagnosed as carcinoma of the rectum, having seen the growth 8 to 10 centimetres above the anal margin by proctoscope. After

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opening through a mid-line incision no carcinoma of the rectum could be found. But on examining the sigmoid, in the upper third was a well-defined annular growth which was excised with an end-to-end anastomosis. There have been several examples where the growth telescoped down into the rectum and this possibility should be emphasized because there is no mention of it in the literature on carcinoma of the rectum.

DR. WILLY MEYER emphasized the necessity of recognizing the possibility of intussusception in the presence of malignancy of growths in the rectum. The speaker had seen it in a growth of the caecum which was carried into the transverse colon. In another case, a young girl complained of pain in the region of the transverse colon and there were signs of sudden, acute obstruction requiring exploration. The tumor was a lipoma of the large intestine.

DR. JOHN DOUGLAS referred to a case on which he operated several years ago. The operation was started with the posterior approach, the growth slipped away and he stopped operating from below and did a Mikulicz type of operation. In a second case, on examination a carcinoma was felt within 3 inches of the anal margin but on subsequent examination it went up to 10 to 14 inches from the anal margin and could not be felt per rectum. In that case it was easy to do a Mikulicz operation. If one feels a tumor and cannot determine on which side of the rectal wall the tumor appears to take its origin, it is possibly one of those cases which prolapse. This possibility must be kept in mind.

### SARCOMA OF CERVICAL VERTEBRA

DR. CHARLES E. FARR presented a girl, sixteen years of age, who was referred to him three years ago because of severe intermittent pain in the left side of the neck. She entered the New York Hospital January 10, 1929.

This cervical pain was of eight months' duration. There was a marked feeling of stiffness and sharp pain on any abrupt movement. This was temporarily relieved by baking and massage. After a month's respite from treatment the pain became more severe and lasted longer, two or three hours instead of a few minutes. An added symptom was a dull ache on the outer aspect of each arm and forearm, also intermittent. Many treatments were tried by several physicians, without benefit.

The past history was negative except for chicken pox (nine years ago), measles (two years ago), mumps (six years ago), scarlet fever (four years ago), and swollen glands in the neck (seven years ago). The tonsils had been removed five years ago.

Examination revealed nothing except slight limitation of extension of the neck, and marked tenderness throughout the posterior triangle of the left side of the neck. Consultations with two neurologists and a physician resulted in a unanimous verdict that the trouble lay in the fourth or fifth cervical vertebra, and was probably not tuberculous.

Repeated X-rays showed no definite changes in the bones. Urinalysis was negative; blood counts were normal; intradermal tuberculin tests were negative; and four Wassermann tests, including one provocative, were normal. The temperature was sub-febrile, 98° to 100° F.

An exploratory operation was done January 23, 1929. Through a transverse incision behind the left sternocleidomastoid muscle, the transverse processes of the fourth, fifth and sixth cervical vertebrae were exposed. They seemed slightly rough but no definite infectious lesion could be found. All soft tissues, especially the muscles, seemed contracted, even partially cicatrized.

## SARCOMA OF CERVICAL VERTEBRA

The child made an excellent recovery and was allowed home on the ninth day. She continued to improve for about a year but was never quite free from symptoms. She was seen by an orthopedic physician, Doctor Boorstein, who had another X-ray taken and referred her back to Doctor Farr with the proper diagnosis of new growth of the spinous process of the sixth cervical vertebra. A review of the original films immediately disclosed a tiny lesion about 3 millimetres in diameter in the spinous process of the sixth cervical, which had been completely overlooked.

By now the growth had involved the fifth spinous process (Fig. 10) and was causing distinct cord symptoms in the arms. She was again operated upon in the New York



FIG. 10.—Giant-cell sarcoma of cervical spine.

Hospital December 17, 1930. Through a vertical incision the spinous processes of the fifth and sixth vertebrae were exposed and removed. They were nearly completely destroyed by the growth which also impinged on the laminæ. The posterior fascia of the canal was exposed but it was not involved. No spinal fluid escaped—no spinal nerves were seen although the cord was clearly visualized. The entire wound was vigorously curetted.

Again recovery was uneventful. The child wore a leather collar for several months and has received fairly intensive X-ray treatment. She now is perfectly well, has no symptoms, has nearly perfect function of the neck, and the X-ray shows an excellent fusion of the fifth and sixth cervical vertebrae.

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The great interest of this case lies in the fact that with the most intensive study in two large clinics and by many private physicians the diagnosis was not made for two and one half years, although it really appeared in the early X-ray plates.

The laboratory reports are appended. They explain the extreme rarity of the condition and perhaps offer a slight excuse for the delay in diagnosis.

Laboratory No. 42,872 and No. 42,863.—Specimens received the morning of operation and later that day are essentially similar. They come from the tissue of cervical vertebrae. In both together there are about twenty pieces of pinkish tissue, some partly bony. The largest ones are a centimetre or so in length.

Microscopically, they are made up of tissue which is in part quite dense, in others less so. Two types of cells predominate, one appearing to represent osteoblasts which



FIG. 11.—Giant-cell sarcoma of cervical spine.

are laying down osteoid and also relatively regular bony trabeculae; while in other areas "epulis"-like giant cells predominate. Here the process is essentially bone-destroying. The picture (Fig. 11) seems to fit in with that of a low-grade, bone-producing sarcoma, rather more definitely than with that of a strictly benign giant-cell tumor. The rather slow growth of the process, clinically, fits in with the pathological picture.

Doctor Ewing has seen the slides and above is in part based on his study. He does not recall having seen either benign or malignant bony tumor in the cervical vertebrae. *Diagnosis*.—Giant-cell tumor or osteogenic sarcoma.

This case has been registered in the "Registry of Bone Sarcoma" as No. 1186. We are informed that in the registry there are twenty-seven tumors of the vertebrae. Of these, only three were located in the cervical region, namely: No. 44, a benign giant-cell tumor of the third, fourth and fifth cervical regions; No. 1018, a giant-cell tumor, malignant, of the fourth, fifth, sixth and seventh cervical vertebrae, and No. 1032, osteogenic sarcoma of the sixth (right) cervical vertebra.

## INOPERABLE CANCER OF STOMACH

### INOPERABLE CANCER OF STOMACH. RESULT OF ACIDOSIS TREATMENT. FOLLOW-UP THREE YEARS

DR. WILLY MEYER presented a woman the history of whose case was published in detail in the last issue of the American Journal of Surgery, January, 1932.

*Recapitulating.*—Gastric trouble in the spring of 1928. At Battle Creek Sanitarium cancer of the wall of the stomach was diagnosed and pronounced inoperable. Desiring operation, the patient went to Rochester, Minnesota, where Dr. Charles H. Mayo did an exploratory laparotomy October 31, 1928. There were many adhesions in the upper right abdomen, secondary to an appendectomy and cholecystostomy done elsewhere in 1916. The upper three-fourths of the stomach including all the posterior wall and part of the anterior wall was involved with carcinoma; there was also involvement of the lymph nodes about the cardia just beneath the diaphragm and along the spine. A gland removed from the gastrocolic omentum for biopsy showed carcinoma. As there was no obstruction a gastroenterostomy was not done and the abdomen was closed as an exploration. Eleven days later the patient left the hospital and soon returned to New York with a fatal prognosis.

Her husband, having read in the newspapers about Professor Fischer-Wasels and Holfelder's coöperative work at Frankfurt University, Germany, arranged for the transfer of the patient to that city. On December 9, 1928, the acidotic treatment as used there for some time in inoperable cases of carcinoma was started. This consisted of increasing doses of hydrochloric acid internally, inhalation of a mixture of oxygen and carbon dioxide, 95.5 to 4.5 per cent., two hours daily, and deep X-ray irradiation for fifteen minutes once a week.

After four months the tumor had disappeared, as proved by the X-ray film. The patient returned to New York in May, 1929, continuing here the acid treatment internally to date, and the gas breathing until September, 1929.

Today, somewhat longer than three years after the beginning of the acidotic treatment, she is still in perfect health; clinical examination for recurrence and metastases is negative. To all appearances the patient has to be considered cured. The pH of the blood is carefully watched here. Should it rise to and above 7.40 gas inhalation will have to be resumed.

Of course, one swallow does not make a summer. A series of similar observations is required before one can venture to draw conclusions. Yet, the experience had with this treatment demands continuation of the work.

The speaker had advised the acidotic treatment in his recent book on "Cancer" on the basis of a careful study of the so-called miraculous cures of inoperable cancer cases, as reported in the literature. In every instance the effect of what had been used or what had occurred incidentally pointed to acidosis.

It seems that those who practice acidotic treatment in inoperable cancer are on the right track in their endeavor to improve the condition of these usually hopeless cases, perhaps even to helping them definitely and permanently. That means, of course, those who believe in the possibilities of acidotic therapy in these cases. But this is not a one man's nor a one hospital's job. The surgeons of the whole country, nay, of the whole world should step in and assist in solving the many problems constantly arising.

The clinical work should be done in closest coöperation with the members of other branches of medicine, the pathologists and the cancer research

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workers, as well as with the representatives of affiliated branches of science, as biological physicists, biological chemists and experts in the electrical field.

There is unquestionably, we believe, something promising in the acidotic treatment of inoperable malignant tumors, combined with deep X-ray irradiation or radium-ray application.

The case presented shows the truth of the statement made that "inoperability does not necessarily mean incurability."

DR. EDWIN BEER said that he had seen a number of cases which had received the acidotic treatment and in none had there been any cures. The more one thinks one knows of malignancy, the less one finds one knows, which is well illustrated by the following unusual case that had no kind of post-operative treatment, whether acidotic or röntgen, and who carried quiescent metastases from a malignant uterine growth for eleven years.

Within the last six months, the speaker saw a woman on whom a total hysterectomy for adeno-carcinoma of the uterus had been performed eleven years ago. The patient came to him for haematuria. She had a post-operative ventral hernia and a nodule was present, supposed to be omental, but proved to be adeno-carcinoma. Moreover, half the bladder was taken out for an infiltrating tumor. At the time of the operation for the hernia and bladder neoplasms, Doctor Beer did not know of the pathology found at the previous operation, but he got in touch with the laboratory of the Roosevelt Hospital, and found that the microscopic diagnosis on the uterine growth was adeno-carcinoma, identical with the microscopic picture of the hernial and bladder neoplasms. All slides were compared. While the patient was convalescing from the bladder operation, another adeno-carcinoma was detected on the labium minus, and removed. In this case, there were at least three malignant metastases some eleven years after the hysterectomy. Five months have elapsed since Doctor Beer's operations, and the patient seems in perfect health.

DOCTOR MEYER, in closing the discussion, reiterated his belief in the value of the acidosis treatment, demonstrated by the presented case. There was abroad one other case he remembered in particular, a case of recurrent cancer of the breast. The woman had a metastasis in the brain, diagnosed by the Professor of Neurology and Ophthalmology of the University of Frankfurt. Under acidosis treatment both the tumor and the metastasis disappeared. Neither X-ray nor radium therapy alone could have accomplished this. Basing his opinion upon such cases Doctor Meyer ventured to state that there seems to be value in the method of this treatment used abroad in combination with or without X-ray or radium treatment. Deep X-ray treatment also produces acidosis. Other methods are being worked out at the Lenox Hill Hospital.

His object in presenting this case, Doctor Meyer said, was to try to interest his colleagues in giving the acidosis treatment a test in cases of inoperable cancer. It is true, nobody wants to place them in the surgical wards, but one or two beds could be set aside for them, for it is only gradually and by coöperation of many clinicians that the real value of the acidosis therapy can be determined.

## THROMBOSIS OF SPLENIC AND PORTAL VEINS

### THROMBOSIS OF SPLENIC AND PORTAL VEINS WITH RECANALIZATION. SPLENECTOMY FOR GIANT SPLEEN

DR. EDWIN BEER presented a boy, fourteen years of age, admitted to Bellevue Hospital, Fourth Division, October 18, 1928, with the following history: Family history negative; one brother, three sisters in good health; father and mother living and well. No history of tuberculosis or malignancy in the family.

In 1925 the boy had been in New York Hospital for seven weeks and was discharged with diagnosis of intestinal tuberculosis, arrived at through barium series, which showed filling defect of the cæcum. X-ray of the chest showed signs of tuberculosis of the hilus. Patient had had no operations; as a child had had diphtheria.

The chief complaint on admission to Bellevue was vomiting of a large quantity of blood, which came on suddenly, unprovoked, while at school. He also had pain and cramps in the abdomen and nose bleeds. The patient was pale and anaemic. Examination showed palpable spleen in the upper left quadrant, some tenderness in the epigastrium. Clinical impression was typhoid fever or tubercular ulcerations with haemorrhage. Further study of the patient led to an exclusion of both these diagnoses, and it was suspected he might have a bleeding gastric lesion. He vomited repeatedly and passed tarry stools on numerous occasions. Vomited blood was bright red.

His condition became worse, so that he had to be transfused during the months of October and November five times. Throughout this period, he ran a moderate temperature, and at times was almost stuporous. Blood count showed 1,000,000 red blood cells, 18 per cent. haemoglobin, 13,400 white blood cells, with 91 per cent polymorphonuclears. Platelet count was normal. While under observation no purpuric spots developed, and there was no evidence of any disturbance in clotting time nor bleeding time.

Suddenly an ascitic accumulation developed with distention, rather extreme, of the whole abdomen. By the first week of November, the spleen, which had been just palpable, became much more distinctly palpable, also enlarged and firm. Wassermann reaction on repeated tests was negative.

He was seen repeatedly by the various members of the staff, and one of them suggested tardy hereditary specific splenomegaly with hepar lobatum, associated with thrombosis of portal vein, which would account for the very rapid development of ascites. As the ascitic fluid slowly but definitely disappeared, the mass in the left side of the abdomen, which was thought to be spleen, seemed to become more evident.

In view of the previous diagnosis made at the New York Hospital, some of the clinicians were inclined to think that in addition to the spleen, the whole descending colon was involved in a hypertrophic tuberculosis. According to the medical history, there were two masses, one under the costal margin, the other just below it, latter mass extending into the left iliac fossa, corresponding to the course of the descending colon.

In December before Christmas, the boy was allowed to leave the hospital for the holidays, having improved; no more bleeding, ascitic fluid had disappeared, but there was still this large mass in the left side of the abdomen.

January 9, 1929, the boy was seen by Doctor Beer for the first time. A diagnosis of splenomegaly was made, with acute thrombosis of the splenic vein, previous thrombosis of the portal vein with recanalization. With this diagnosis, operation was recommended, and January 14, an enormous spleen was removed through a subcostal incision parallel to the costal arch. The spleen was surrounded by adhesions and innumerable varicose veins, which entered the splenic hilus. There was no ascites, liver was smooth and not enlarged. The most interesting thing, outside of the size of the splenic mass, was the innumerable large veins, which had apparently substituted for the obliterated splenic vein. Over sixty separate vessels and groups of vessels had to be ligated before the spleen could be delivered. These veins also ran from the splenic flexure of the colon into the lower pole of the spleen. The pancreas was easily separated from the hilus.

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Patient was transfused after operation, and except for a collapse of the left lower lobe, made an uneventful recovery.

The specimen weighed 895 grams, was 14½ inches long, and 5¾ inches at its greatest width, firm in consistency, smooth surface with round borders. Hilus surface presented numerous ligations longitudinally arranged and extending from tip to tip. The markings were obliterated. Histological changes suggested chronic syphilitic splenitis.

The patient was reexamined the other day, three years approximately since the splenectomy, and found to be actively engaged as a fireman on a boat, and apparently in perfect health. The subcostal incision is perfectly healed, without any weakness, and his abdominal examination is negative. Blood examination shows normal conditions with Howell-Jolly bodies in the red blood cells. (Rosenthal.)

DR. DEWITT STETTEN said that in 1922 he had the opportunity of operating on a case similar to Doctor Beer's, but with, unfortunately, not the same successful outcome. The patient, a male, twenty-one years old, was referred to him from the medical service of the Lenox Hill Hospital with a history of sharp sticking pain in the left side of the abdomen and lumbar region with vomiting. The patient had been ill for two weeks prior to his admission to the hospital. Upon admission he had a moderate splenomegaly, which rapidly increased to unusual proportions while under observation during a period of two weeks. The patient at first was in very good condition. The temperature was relatively low, 100°, but it gradually rose to 103-104° just prior to the operative interference when the patient's condition became critical. His pulse was rapid and thready and he was in a state of delirium. There was also a rather marked leucocytosis. The pre-operative diagnosis of acute splenomegaly due probably to abscess of the spleen or possibly to a rapidly growing primary neoplasm such as lymphosarcoma was made. At operation Doctor Stetten found an enormous purplish and dark-gray mottled spleen showing areas of infarction with necrosis and haemorrhage, and an extensive thrombosis of the splenic vein, but no discoverable portal vein thrombosis as apparently existed in Doctor Beer's case. No evidence of typhoid fever or other possible causative factor was found at operation. The patient succumbed and, as no post-mortem examination was made, the etiology of the condition was never definitely explained. The speaker believes, however, that the case was a primary splenic vein thrombosis and feels that, had the diagnosis been made a little earlier or at least the operative indication decided upon sooner before the patient's condition became so alarming, he might have been saved. As to the incision for splenectomy Doctor Stetten said he also favored the oblique incision parallel to the costal arch, but that he preferred to make it a little nearer to the arch than the one used by Doctor Beer in his case. One should be guided by the size of the splenomegaly as regards the proximity to the costal arch—the larger the spleen, the further away should the incision be from the arch. Doctor Stetten has never experienced any difficulty in doing the splenectomy through this incision, nor has he ever seen any subsequent weakness of the scar.

## TWO-STAGE ABDOMINOPERINEAL OPERATION OF RECTUM

DR. EDWARD J. DONOVAN said that he had used the same incision as that used by Doctor Beer at least fifteen times, and, so far, has not had a ventral hernia develop. This incision gives an excellent exposure of the spleen, and although one cuts across at least four intercostal nerves, the incision will remain secure if closed carefully in layers.

## TWO-STAGE ABDOMINOPERINEAL OPERATION FOR CANCER OF THE RECTUM BY THE LAHEY TECHNIC

DR. HERBERT WILLY MEYER presented a man, sixty years of age, who in June, 1931, was admitted to the Surgical Service of Dr. Carl Eggers at the Lenox Hill Hospital with the complaint of pain in the lower abdomen and rectal bleeding. From the history, physical examination, X-ray, clinical, laboratory tests and biopsy a diagnosis of adenocarcinoma of the rectosigmoid was made.

This surgical problem immediately brought up the problem which method of approach afforded the best solution for the total removal of the lesion. It was decided to do a combined abdominoperineal operation in two stages with the formation of an end colostomy.

Appended is a chart of the different methods of two-stage operations together with the principles of the operations, their advantages and disadvantages.

By examination of the chart it is seen that the most ideal procedure is the one-stage operation with formation of a colostomy and removal of the lower segment in lesions situated at the junction of the sigmoid and upper rectum. The formation of a sacral colostomy is more disagreeable for the patient and more difficult to care for. In lesions situated at the upper rectum and lower sigmoid, radical cancer surgery demands the removal of the entire lower loop with sacrifice of the much-desired sphincter muscle. Technically it is desirable either to maintain the sphincter muscle and pull the colon through it or to make an end-to-end anastomosis just above the level of the sphincter. From the radical cancer viewpoint these procedures are not advisable.

It is also necessary to be able to do a careful lymph-node dissection of the nodes lying along the inferior mesenteric vessels which drain the tumor-bearing area.

Of all the methods described in the chart one finds that the Lahey technic answers all these desiderata in the best way if a two-stage operation is desired. The basic principles seem excellent and his method does away with most of the disadvantages of the other methods.

The technic advised by Doctor Lahey was described by him in his article in *Surgery, Gynecology and Obstetrics* in November, 1930. In concise form the main procedure is as follows: Mid-line incision between the umbilicus and the pubis. Exploration for metastasis and operability of the tumor. Determination of a point on the sigmoid colon well above the tumor which will easily reach the surface of the skin above the pubis. At this point incision of the peritoneum on either side of the meso-sigmoid and division of all vessels from the margin of the intestine down to the promontory of the sacrum avoiding the superior hemorrhoidal artery and vein.

Counter incision in the left inguinal region mid-way between the umbilicus and

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anterior superior spine for emergence of the permanent colostomy. A long Ochsner clamp is introduced through this wound and grasps the colon at the point where the vessels have been divided. Another Ochsner clamp grasps the sigmoid in the mid-line wound just below the point of the first clamp. The intestine is divided with a cautery, sterilizing the cut margins.

The first clamp with sigmoid is withdrawn through the colostomy wound. The counter incision is closed, surrounding the colon in layers but not grasping the colon wall to avoid penetration leakage and infection. The clamp is left in place in the dressing until the colostomy is to be opened.

Method	One-stage abdomino-sacral procedure	Niles procedure, 1912	W. J. Mayo's procedure, 1912	Rankin's procedure, 1929
Stages	1-Stage	2-Stage	2-3-Stage	2-Stage
Principles of Operation	Obstructive colostomy Establishing an obstruction colostomy and at the same time removal of entire lower loop with tumor, with extension pelvic dissection and pelvic drainage	Obstructive colostomy Colostomy established. At same procedure all vessels to rectum divided and lower loop pushed into pelvis and extra-peritonealized by closing peritoneum above it	Non-obstructive loop colostomy All blood supply divided. Blind efferent loop of non-obstructive colostomy which sometimes needs removal later. Pelvic dissection and leaving dead loop in pelvis as in Niles procedure	End colostomy Lower divided distal end of colon closed and dropped back into abdominal cavity, keeping blood supply for lower segment till second stage
Advantages of operation	Answers cancer principles best. Colostomy and removal tumor in one stage. The Ideal! Method	Second stage extra-peritoneal	Non-obstructive colostomy	Maintains blood supply to lower colon between stages and establishes non-obstructive colostomy
Disadvantages of operation	Shock and high mortality	Obstructive colostomy Extension pelvic dissection with raw surfaces into which a dead segment of bowel containing infected faeces is imbedded in pelvic pocket closed by suturing pelvic peritoneum over it	Same as for Niles plan except colostomy being non-obstructive. Danger opening blind end of efferent loop of colostomy with resulting infection and possible peritonitis	Closed blind lower segment between stages. Prevents irrigation lower segment and removal faecal material. Impractical if obstruction at site of neoplasm

The mesentery of the upper loop is sutured to the parietal peritoneum in the iliac fossa to prevent herniation and strangulation of the ileum behind the colon.

The mid-line incision is sutured in layers above the lower loop which emerges just above the pubis and to which the clamp is still attached. This tissue cuts through in about a week and the intestine is opened. The colostomy is opened when considered wise.

When the lower loop is open the loop is irrigated daily with a rectal speculum in place to allow free flow of fluid.

Before the second stage is performed the lower loop is irrigated daily with either S.T. 37 or with mercurochrome in order to get the loop as sterile as possible. When the patient is in good enough condition the second stage is performed. The colostomy

## TWO-STAGE ABDOMINOPERINEAL OPERATION OF RECTUM

opening just above the pubis is circumcised and the opening closed and the abdominal wound is again reopened. The stump is painted with iodine. The peritoneum over the superior haemorrhoidal vessels is incised and the vessels are ligated. The peritoneum is then incised along either side of the rectum and in front, and the dissection is carried downward into the hollow of the sacrum and laterally together with the lymph nodes tissue. In front the rectum is separated from either the bladder or the uterus. This is continued down to the level of the coccyx. The intestine is pushed down and the pelvic peritoneum is closed above the intestine and the abdominal wound is closed.

The patient is then placed in the right Sims' posture. The anus is sutured. The

Cæcostomy	Dahlgren's procedure, 1913	Jones procedure, 1915	Coffey's procedure	Lahey's procedure, 1930
2-Stage	3-Stage	2-Stage	2-Stage	2-Stage
Cæcostomy to overcome obstruction Cæcostomy to overcome obstruction and then to follow with one of other procedures	Preliminary closed cæcostomy Ligation of central vessels preserving vascular arch close to sigmoid. Cecum attached to right side and sigmoid dropped back. Opening cæcostomy second stage. In third stage dissection from peritoneum and formation of blind extra-peritoneal stump	Non-obstructive loop colostomy Central ligation vessels maintaining vascular arch. Separation and dissection of rectum from sacrum, bladder or uterus and lateral attachments and then suturing freed pelvic peritoneum to colon above point where it was to be divided above tumor and above point of central ligation vessels. In second stage removal completely extra-peritoneal	Colostomy 1. Ligation all vessels to rectum. Suture rectal tube to ligated distal end colon. Withdrawal of tube and telescoping rectum on itself till pulled through and out at anus. 2. Placing dead loop into pelvis as in Niles plan except with drainage	Non-obstructive colostomy Establishing end colostomy. Maintaining blood supply to lower intestine but instead of dropping same into abdomen as in Rankin plan, the lower colon is placed in lower angle median wound and lower colon can thus be irrigated and partially sterilized. In second stage blood supply is divided and pelvis dissected from above and then removed completely from below with adequate drainage of pelvis
Overcomes obstruction symptoms	Maintenance of blood supply	Permits establishment of facial stream, and irrigation lower loop between stages and interval between stages. Second stage can be performed extra-peritoneally	Drainage established to dead segment with possibility of some delay between stages.	Non-obstructive colostomy. Division operation into two stages of which two is more extensive. It is nearest to ideal one-stage plan. Delay between stages possible. No dead bowel implanted into freshly dissected pelvis. Second stage involves removal clean, empty rectum. Good drainage established
Fluid contact bowel at cæcum Only partial side-tracking intestinal flow	Many obvious disadvantages including cæcostomy	Blind distal open if sigmoid must be left. Difficult intra-pelvic extra-peritoneal technique with division sigmoid and closure of end of sigmoid. Shortness of some meso-sigmoids in order to reach below pelvic peritoneal dia-phragm	1. Telescoping impossible in tumors that constrict rectum 2. Same as in Niles procedure	None except that it is two-stage operation. Peritoneum of pelvis cannot be closed from above if tumor is very large. This is a very minor disadvantage. Difficult in very obese patients to bring distal end cut colon to skin surface.

coccyx is resected and the rectum and anus are easily dissected and the entire lower loop is removed in one piece. A large pelvic drain is placed.

The first stage of the operation in the case presented this evening was performed without knowledge of Doctor Lahey's technic and was therefore performed according to the speaker's ideas, which, however, were not as good as those of Doctor Lahey. He doubly ligated the colon and the efferent lower loop was buried with a silk purse-string. This was opened later.

The Ochsner clamp method is much simpler and more preferable. The second stage (Fig. 12) was performed according to Doctor Lahey's technic after attention had been brought to his publication. The patient, sixty years of age, had a bad myocarditis and

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both stages were performed under spinal neocaine anaesthesia. The second stage was performed under two separate injections of spinal anaesthesia, one before the laparotomy and the other after the patient had been turned onto his side. It might have been possible to perform the entire operation with one injection but we wanted to surely avoid inhalation anaesthesia and therefore two injections were given. There was not the slightest shock to the patient from either one of the stages.

**CASE REPORT.**—C. L., a male, sixty-one years of age, was admitted on June 9, 1931, with the chief complaint of bleeding from the rectum for four years, pain in the rectum for one year and prolapse of the rectum for one and one-half years. The bleeding occurred every two to three months for the past four years, the last time one week before admission. The rectum prolapsed at every bowel movement for one and one-half years. For one year he had cramp-like pain in the lower abdomen especially on the left side. This was relieved by a bowel movement or by haemorrhage. For the past eight months there was marked mucous discharge. Stool was blood-tinged and ribbon-like. Some diarrhoea. Had lost 22 pounds in weight in one year, 10 pounds in the last three months.



FIG. 12.—Photograph of lower segment of sigmoid, rectum and anus removed in second stage of Lahey's two-stage abdominoperineal operation showing tumor at recto-sigmoid junction.

Seventeen years before admission haemorrhoidectomy. No history of cancer in family.

**Physical examination.**—Head and neck negative. Prolapse of the rectum. Prostate normal. A mass was palpable one inch above the prostate about the size of a hen's egg. There was blood on the examining finger. The lower limit could just be touched by the finger. The liver was not enlarged.

**X-ray examination** reveals a deformity at the rectosigmoid juncture.

**Proctoscopy.**—Tube introduced 5 inches. Tumor seen. Biopsy taken. **Diagnosis.**—Adeno-carcinoma of rectum.

First stage of operation on June 15 under spinal anaesthesia. Orange-size tumor found at juncture of rectum and sigmoid. Freely movable with no evident lymph-node metastasis. Not adherent. Sigmoid freed by incising lateral peritoneum. Division of mesentery down to superior haemorrhoidal vessels. Distal end of divided colon closed and invaginated. Proximal end ligated and cauterized and brought out through a lateral incision. This wound was closed in layers catching the wall of the colon. (This later gave a local infection and lateral perforation of the colostomy which had to be divided into end opening.) The abdominal mid-line incision was closed in layers with through and through heavy silk sutures and a piece of rubber dam was placed above the lower segment. This according to Lahey's technic is not necessary.

## TWO-STAGE ABDOMINOPERINEAL OPERATION OF RECTUM

The colostomy was opened June 17. The rubber dam was removed June 23. Infection around colostomy on June 24. Lower loop was opened June 26 and irrigations through this loop were begun daily. The patient was allowed out of bed July 19.

The second stage of the operation was performed August 5, all of this time having been used to get patient into better condition and to improve the myocarditis. Spinal anaesthesia. Mid-line colostomy closed. Free peritoneal cavity easily entered. One loop of ileum adherent to sigmoid easily freed. Superior haemorrhoidal vessels ligated. Peritoneum and meso-sigmoid and rectum incised. Bladder pushed away. Entire mass could not be pushed into pelvis on account of size of the tumor and the pelvic peritoneum could not be sutured above intestine at this time on account of size of tumor. Abdominal wound closed in layers with drainage and with through and through silk sutures.

The patient was placed in right Sims' posture. An additional injection for spinal anaesthesia given, 150 milligrams neocaine each time. Anus closed by suture and mid-perineal incision. Coccyx removed. Rectum dissected free and entire lower segment of bowel easily removed. Tampon placed in pelvis. Peritoneum sutured about it and lower wound disinfected with 5 per cent iodoform ether. Packed with gauze.

The convalescence was smooth. September 23 the abdominal wound was entirely healed and November 7 the perineal wound was also closed. Patient was discharged on that day. He had been kept in the hospital all that time because he had no home where he could receive proper care.

*Pathological report.*—The specimen was 40 centimetres long; 10.5 centimetres above the anus was an annular, irregular, necrotic growth, 5 centimetres in length and 7 centimetres in diameter. Eight smaller and larger lymph nodes were examined. Microscopical examination showed a typical adeno-carcinoma. There were many mitoses. Acini were large and lined with multiple layers of cylindrical cells. The growth deeply infiltrated the gut wall, reaching at one place almost to the thickened serous coat. There were large areas of necrosis and suppuration.

The regional lymph nodes examined showed no evidence of secondary tumor deposits.

*Follow-up.*—It is now five months since the second stage of the operation and the patient is in good condition with no evidence of local or distant recurrence.

**CONCLUSIONS.**—(1)—The Lahey technic seems to be the nearest to the ideal one-stage procedure and is the safest method of combined abdominoperineal removal of a cancer of the rectosigmoid in two stages.

(2)—Delay between the stages is possible.

(3)—An end colostomy is performed.

(4)—The entire lower loop with the regional lymphatics can be dissected and removed after freeing it of all faecal content and having it as near sterile as it is possible to get it.

(5)—Adequate pelvic drainage can be instituted.

(6)—The operation is divided into two almost equal stages in which the second stage is the major of the two stages at a time when the condition of the patient has been markedly improved.

(7)—The only disadvantage, besides a two-stage procedure, is a possible difficulty of bringing the distal end of the divided colon to the skin surface above the pubis in very obese patients.

DR. CHARLES L. JANSEN called attention to the necessity of different technic when dealing with cases of carcinoma of the rectum. The most satisfactory in general is the abdominoperineal in one stage. But obesity in some cases makes this dangerous, especially in the male where the pelvis is

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narrow and deep. The speaker referred to a case in which he did an operation similar to the Lahey technic, but he did not see what benefit was obtained except that a colostomy being performed it is possible to irrigate the lower part and get the rectum perfectly clean. He thinks that the two-stage technic used by Jones or Coffey has probably more advantages than the Lahey technic. If two stages should be preferred the first should be strictly abdominal and the second strictly perineal to limit the shock.

DR. FRANK S. MATHEWS referred to two cases, both one-stage operations. The first required catheterization all the time he was in bed and even then could not empty the bladder completely. In the second case the patient could void from the first day and never had any trouble in this respect.

DR. JOHN C. A. GERSTER said that in the case of a very stout man he tried the Lahey technic. A short bowel made it impossible to get good union with the skin. There was local infection. At the second operation there were many adhesions. The patient was a very stout man with a small pelvic cavity. If he had such a case again he would do the one-stage operation because of the delay and danger of infection around the wound. The Lahey operation may be successful with thin people but not in very stout ones with a short meso-sigmoid.

DR. FORDYCE B. ST. JOHN said that, although relatively infrequent, the complications which may arise as a result of early retraction into the peritoneal cavity of the colostomy stump should be born in mind.

DR. FREDERIC W. BANCROFT, referring to the bladder complications, said that he recently had a patient who, two weeks after an argyrol irrigation, passed black urine and it was impossible to tell if this was argyrol or the result of some infection. As to the Lahey operation there was one difficulty which was illustrated by a recent case of a woman with a high tumor in which it was necessary to do a two-stage operation. The difficulty in bringing the proximal end up caused sloughing of the proximal loop and a stricture developed which it was hard to dilate and keep open. Eight months after the operation she developed partial obstruction and at operation half of a prune pit was found. She died the next day. Post-mortem revealed a perforation within the peritoneal cavity with diffuse faecal peritonitis.

DR. CHARLES E. FARR asked if this operation destroys the nerve supply of the bladder and, if so, why do the patients recover bladder function later on.

DOCTOR WHIPPLE replied to Doctor Farr's question that he did not see how there could be much nerve supply left after this operation. Jones, of Cleveland, recently wrote to him that he was making an effort to preserve some of the plexus but felt, on the other hand, that if one paid too much attention to that one would not get the peri-rectal tissue that contains the lymph nodes. Why these patients do not become permanently disabled as

## COMPLICATIONS OF ABDOMINAL PERINEAL RESECTION OF RECTUM

far as bladder function is concerned the speaker did not know. In regard to anaesthesia, many surgeons have experienced the advantages of spinal anaesthesia up to the end of one hour and after that being faced with the necessity of using another anaesthetic. Perhaps that is why Myles, of London, times his operation for one hour. But he selects his patients, ideal as far as lack of obesity is concerned. He also has very good assistants and that is of great importance in developing a technic and shortening the operative time.

DR. HERBERT WILLY MEYER said that the patient he had presented that evening had been operated upon under spinal anaesthesia on account of the fact that he had a very bad myocarditis.

The entire operation of the second stage of the procedure was performed under spinal anaesthesia and this was maintained by two separate injections of 150 milligrams of neocaine. The first injection was made and then the laparotomy performed whereupon the patient was turned into the right Sims' posture, and a second injection was made before the perineal work was done. Only one injection of ephedrin was given at the beginning and the patient went through the operation without any evidence of shock whatsoever, excellent analgesia being maintained throughout. It seems that one can use two injections of spinal anaesthesia without much danger. Bartlett, of St. Louis, has also used this method, reversing the procedure and first operating perineally and then performing the laparotomy under two injections of spinal anaesthesia.

Doctor Meyer stated that he did not mean that the Lahey technic should be used in every case of carcinoma of the rectum but he did wish to state that in certain cases it certainly was the safest and most ideal method.

## THE COMPLICATIONS OF ABDOMINAL PERINEAL RESECTION OF THE RECTUM

DR. ALLEN O. WHIPPLE read a paper with the above title for which see page 916.

TRANSACTIONS  
OF THE  
PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD JANUARY 4, 1932

The President, DR. GEORGE P. MULLER, in the chair

CALVIN M. SMYTH, JR. M.D., Recorder

AVULSION SKIN OF HAND

DR. HUBLEY R. OWEN presented a man twenty-seven years of age who, July 20, 1931, as a result of an automobile accident, sustained a lacerated wound of the scalp, cerebral concussion and a severe laceration of his right hand with loss of skin and subcutaneous tissues from the dorsum exposing



FIG. 1.

FIG. 2.

FIG. 1.—Avulsion skin of hand with exposure and sloughing of tendons.  
FIG. 2.—Flap a few days after being freed from chest.

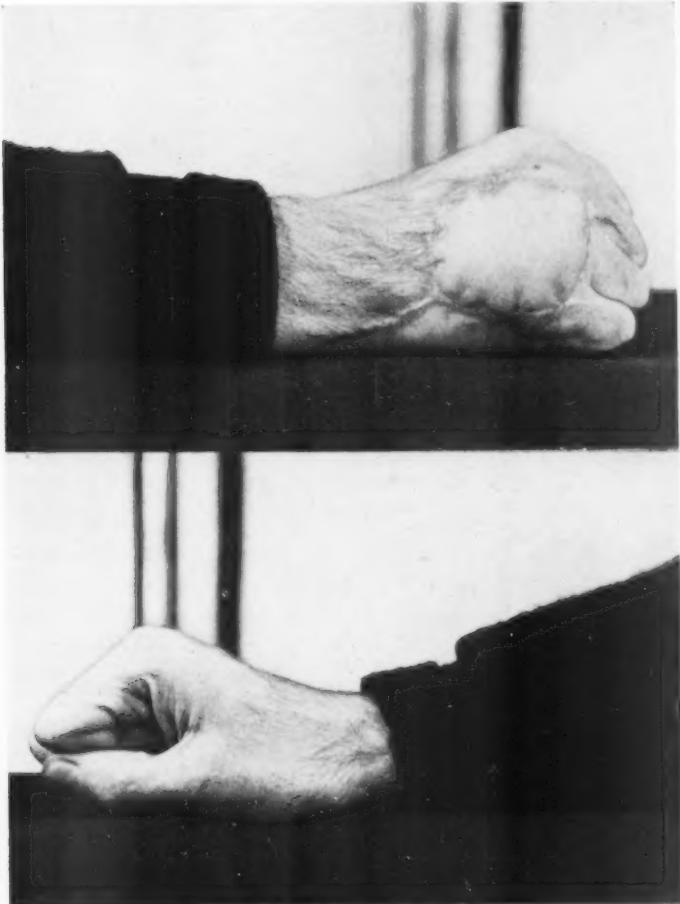
the tendons and deeper structures. The extensor tendons of the four fingers and thumb were badly lacerated. The trapezium was crushed and the joint between it and the first metacarpal was exposed. The wound was cleansed, débrided and part of the trapezium removed. He received appropriate treatment for his cerebral concussion. Cultures from the lacerated wound of the hand showed an organism resembling *B. welchii* as well as the tetanus bacillus. He was given perfringens antitoxin and tetanus antitoxin. The above treatment was rendered at the Atlantic City Hospital.

He was admitted to the Police and Fire Ward of the Philadelphia General Hospital July 24, 1931, at which time (Fig. 1) the dorsum of the right hand was denuded of skin and the tendons of the third, fourth and fifth fingers exposed. The wound was grossly infected. The wound of the

## AVULSION SKIN OF HAND

hand was treated with Dakin's solution by the Carrel method. On July 28 smear and culture from hand were negative for gas bacillus but there were present a few bacilli suggestive of tetanus.

A pedicle flap from the chest was sutured over the wound of the hand on August 21, the graft being freed from the chest wall August 27. (Fig. 2.) He was discharged from the hospital September 3. Massage was first



FIGS. 3 and 4.—End-results.

ordered on October 28. He has regained practically 100 per cent. function with the right hand. (Figs. 3 and 4.) Reconstruction of his tendons has been effected without a secondary operation and he is performing his regular duty as hoseman in the Bureau of Fire.

DR. DEFOREST P. WILLARD discussing whether the graft should be taken from the abdomen or the chest believes that the chest is better as there is not as much fat on the chest as in the abdominal wall. Some years ago he had a patient who had had a very massive burn on the back of the hand. A flap graft had been made when she was seventeen or eighteen years of age and excessively thin. After she had been married she became very stout after the birth of a child. The fat had simulated the fat of the abdominal wall.

## PHILADELPHIA ACADEMY OF SURGERY

DR. HUBLEY R. OWEN said that the flap in his case was taken from the axillary region rather than from the abdomen for two reasons: "First, because he thought the position with the hand in the axilla was more comfortable, and secondly because of his knowledge of a case of Doctor Willard's which developed adiposa dolorosa. Doctor Willard took the flap from the abdomen and when the patient developed increased thickness of the walls of the abdomen, the flap which had been transferred to the hand assumed the same thickness. The graft in his own case was attached to the chest wall for six days. The real interest of the case was the reconstruction of the tendons which were so frayed and sloughed that there appeared to be but little possibility of ever regaining function without operative procedure.

### TRAUMATIC CHOLECYSTECTOMY

DR. HENRY P. BROWN, JR., reported the case of a man of eighteen years who was admitted in the service of Dr. Edward B. Hodge at the Presbyterian Hospital May 9, 1931, with the history that twelve hours previously he had been in an automobile accident, in which, while riding in the rumble seat, he was thrown violently against the front seat of the car. He was brought to the hospital in an unconscious condition. He recovered consciousness soon afterwards and was treated for abrasions of the face and allowed to go home. He returned to the hospital several hours later (twelve hours after the accident), complaining of vomiting and abdominal pain. At this time his temperature was 99°, pulse 92 and respiration 38, the blood-pressure being 138 systolic and 78 diastolic.

He was a well-developed male lying partly on the right side, with the right thigh and leg held in a flexed position. He complained of severe abdominal pain, which he characterized as being knife-like. He was also nauseated and tried ineffectively to vomit. Respirations were rapid and shallow, deep breathing causing abdominal pain. Aside from lacerations of the scalp and chin, examination of the head was negative, as was examination of the chest and its contents. The abdomen showed marked generalized rigidity and tenderness, being more marked under the right costal border. Peristalsis was not heard and there was no demonstrable free fluid in the abdomen. There were no masses present in the abdomen, nor was there evidence of local trauma to the abdominal wall. There was well-marked tenderness over the region of the right kidney, without evidence of a mass. The extremities were negative. The urine showed a specific gravity of 1.030, acid, trace of albumen, 150-200 red blood cells per high-power field. The blood showed 4,320,000 erythrocytes, 20,000 leucocytes, polymorphonuclears 95 per cent. and small lymphocytes 5 per cent. The haemoglobin was 85 per cent. Fluoroscopic examination of the chest did not reveal anything abnormal, the diaphragm moving equally but slightly on both sides.

A diagnosis of abdominal trauma having been made, operation was performed within thirteen hours of the time of the accident. Spinal anaesthesia was employed. The abdomen was opened through a right paramedian incision, revealing a large amount of free blood in the abdominal cavity. Examination of the stomach was negative, as was that of the spleen and intestines. The liver showed a tear 3 centimetres in length on the dorsal surface above the bed of the gall-bladder. Exposure of the under surface of the liver revealed that the gall-bladder had been removed entirely from its bed and was floating free in a pool of blood; it had been severed

## ACUTE INTUSSUSCEPTION WITH REFERENCE TO BOWEL TREATMENT

flush with the common duct. There was also a small tear on the under surface of the liver in the region of the gall-bladder bed. The cystic artery had been severed and was plugged with a clot. After ligating the cystic artery, the orifice of entrance of the cystic into the common duct was closed with one mattress suture of catgut. The torn edges of the liver were sutured with a few catgut sutures and the torn peritoneum was sutured over the ligated cystic artery and the entrance of cystic duct into the common.

About 400 cubic centimetres of free blood were removed from the abdomen, the rest being allowed to remain. A cigarette drain was placed against the bed of the gall-bladder and the abdomen was closed in layers.

Aside from being irrational at times for three or four days, the patient made a normal post-operative recovery. Within the first twenty-four hours post-operatively, he began to drain bile profusely, which continued for six days, at which time it stopped rather suddenly. On the second post-operative day there was a suggestion of icterus of the sclera which disappeared on the third day following. The cigarette drain was removed on the eleventh day, at which time the sutures were also removed, and on May 30, twenty-one days after the operation, the wound had entirely healed. His stool was normal in color; there was no jaundice; his appetite was excellent, and he was discharged as cured. His post-operative temperature ranged from 100 to 101° for five days, becoming normal and remaining so after this time. The urine showed red blood cells only on the first examination. The Wassermann and Kahn tests were negative. Microscopically, the gall-bladder showed complete desquamation of the lining epithelium.

This case was the first time that the reporter had ever encountered a traumatic amputation of the gall-bladder and he was unable to find reference to a similar conditions.

## FRACTURE OF THE SURGICAL NECK OF THE HUMERUS

DR. HENRY P. BROWN, JR., reported the case of a boy nine years of age who was injured February 6, 1930, while wrestling with some other boys. He stated that he was thrown violently to the ground, striking his right shoulder. He had immediate disability of his right arm and was brought to the Pennsylvania Hospital and admitted to Dr. Charles F. Mitchell's service. Examination at this time was negative, aside from his right arm, which revealed a fracture of the surgical neck of the humerus, which was confirmed by X-ray examination. He was put to bed and an extension applied to the arm through a Thomas splint. It being impossible to keep this splint and traction in position, this method was discarded and the arm put up in a sling and shoulder cap. At this time the X-ray showed complete displacement with over-riding of the lower fragment. He was discharged from the hospital February 23. Attempt at reduction had been made first under nitrous oxide and again under ether anaesthesia without improving the position of the fragments. His condition progressed satisfactorily and in three months' time he had resumed his former occupation as a bootblack.

Examination of the arm in October, 1931, which was twenty months after the injury, showed complete restoration of the line of the humerus, there being scarcely any evidence of the former fracture. Function at this time was perfect.

## ACUTE INTUSSUSCEPTION WITH SPECIAL REFERENCE TO TREATMENT BY RESECTION OF THE BOWEL

DR. FREDERICK R. ROBBINS read a paper with the above title for which see page 830.

PHILADELPHIA ACADEMY OF SURGERY

FRACTURE OF THE ODONTOID PROCESS OF THE AXIS

DR. ASTLEY P. C. ASHHURST reported the case of a man fifty-seven years of age, weighing 195 pounds, who was in an automobile accident March 6, 1931, in which the patient was thrown through the top of the car and fell about 15 feet away from its wreck. He did not lose consciousness, but managed to get up on his hands and knees. After having been placed in another automobile he was driven several miles to a dentist's office. He was taken on a stretcher to a hospital in Burlington, N. C., bleeding from his nose and his right ear. He remained in that hospital for three weeks. He was then taken to Asheville, N. C., and was under the care of Dr. Charles Norburn in the latter's hospital. Doctor Norburn applied a plaster-of-Paris dressing including the body and head; when this dressing was removed after being in place four weeks, the patient seemed comfortable without support, and it was not replaced. X-ray films taken soon after the accident (both antero-posterior and lateral views) showed a transverse fracture through the base of the odontoid process, without any displacement. The patient also had a fracture of the right clavicle, and probably also a fracture of the base of the skull on the right.

The patient was sent by Doctor Norburn to Doctor Ashhurst, at the Episcopal Hospital, Philadelphia, June 10, 1931, three months after the accident. He was a stocky, thick-set man, looking his given age. He walked about easily, but with his neck held a little stiffly. All motions of his neck were very limited; he had no pain, he said, unless motions were pushed beyond these limits. Doctor Ashhurst made no attempt at all to force the motions. There was no deformity palpable on the outside of the neck or in the pharynx. A spinal brace, with head extension, was ordered, to be worn constantly except in bed. The brace consisted of a pelvic band, to which were attached two uprights (one each side of the spinal column) which were continued forward over the shoulders; and a headpiece attached to the spinal support by a pivot joint allowing a little rotation of the neck, but no flexion, extension or side bending.

The patient was seen again October 7, 1931. He had been wearing the brace with comfort since June. Recent X-ray films made in Asheville, and by Dr. H. K. Pancoast in Philadelphia, showed the odontoid process in normal position, and with bony union of the fracture across its base. The patient was therefore allowed to discontinue the use of the brace except when in an automobile or railroad train on long trips. Doctor Norburn writes January 1, 1932, that the patient has gone to Florida for his general health (very high blood-pressure, having suffered an apoplectic stroke some time ago). However, the condition of his neck is quite satisfactory; he having about 75° rotation, and slight limitation in flexion and extension.

The patient himself writes from Florida December 30, 1931: "I feel little or no discomfort at all about my neck."

*N.B.*—Magnant (Rev. de Chir., vol. I, pp. 13-33, 1931) finds fracture of the odontoid process of the atlas occurs only in 3 to 4 per cent. of fractures of the vertebral column. As an isolated lesion it is still more rare, only ten cases being recorded.

An excellent article on the subject in German is by Dürck (Beitr. z. path. Anat. u. z. allg. Path., vol. lxxxiv, pp. 353-373, 1930).

DR. WALTER ESTELL LEE recalled three cases of fracture of the odontoid process; two of the patients recovered and the other died suddenly while being

## PSEUDOMYXOMA PERITONEI

given an enema by the orderly. He has at the present time under his care a man seventy-four years of age who was injured in an automobile accident and although he had a painful and rigid neck immediately after the accident, his other bruises seemed to attract more attention. The painful neck persisted and an X-ray picture was taken seven days after the accident. This picture demonstrated a very definite transverse fracture at the base of the odontoid. A brace was applied, which he wore in bed for about a month, but it is now discarded and although there is still considerable limitation of motion, the pain has entirely disappeared and the speaker believes that he can be considered as having recovered.

DR. ADDINELL HEWSON exhibited a specimen showing a fracture of the odontoid process. This is the second one of the kind he has come across, but this one shows roughened areas of the ventral and dorsal surfaces of the body. The other one he found in a dissecting room at Jefferson College, which showed the odontoid process was not united at all; that the area between the odontoid process and the body of the second vertebra was covered with cartilage and apparently the odontoid process had not been disturbed after the fracture had taken place. It is interesting from the standpoint that the callus is on the front part of the vertebra and the other on the dorsal portion. The opening for the large veins which go into the body of the vertebra in this instance is quite large. It is interesting from the position of the odontoid process and the spinal cord. The odontoid process would come very close to the position of a crossing of the fibres in the pyramids of the cord. The speaker had examined eight bodies within three hours after execution by hanging and in none of them did he find any trouble with the odontoid process.

DR. FRANCIS C. GRANT said that he had seen the case of a man thrown through the top of an automobile who sustained a fracture of the odontoid process. The injury went ten days unrecognized and was then diagnosed by X-ray. The man wore a brace for six or eight months and made a complete recovery. As far as the speaker could remember there has been none on the neurosurgical service in the University Hospital for the last five years.

Doctor Ashhurst added, in reference to Doctor Hewson's experience with patients who had been hanged, that it was interesting to recall the controversy which was carried on years ago between the surgeons of Paris and the surgeons of Lyons, France. The former contended that the neck was never fractured by hanging, whereas the latter maintained that it was always fractured. Further investigation showed that the Lyons hangman, being anxious to assure himself of the death of his victims, after removal from the gallows, made a practice of sitting on their shoulders, and *twisting the neck around until he heard it crack!*

## PSEUDOMYXOMA PERITONEI

DR. JOHN W. JEFFRIES, by invitation, read a paper with the above title.

## BRIEF COMMUNICATIONS

### SIMULTANEOUS STRANGULATION OF TWO SEPARATE LOOPS OF INTESTINE

THE following report of a case in which there was present strangulation gangrene of two separate loops of small intestine is reported for four reasons:

(1) As far as can be learned there are no similar cases reported in the literature. The research department of one of our leading publishing companies was unable to find any references in the literature.

(2) Advanced age is not always a contra-indication to rather extensive surgery. When a condition such as this patient had is present in which the outcome without operation is certain death, the patient should be given the chance afforded by operative procedure.

(3) If the few cardinal principles of intestinal anastomosis described by Doctor Halsted are respected, intestinal suturing is a simple procedure and elaborate and time-consuming methods are unnecessary. Doctor Halsted maintained that one row of carefully placed sutures to invert the line of the anastomosis and approximate the serous surfaces was sufficient. In this particular case one row of inverting sutures was used in the end-to-end anastomosis in the small bowel and the Murphy button was used to make the end-to-side anastomosis of the terminal ileum to the caecum. Careful respect to technic, particularly to soiling, was given, but no time was wasted, the entire operation being done in less than an hour and before the spinal anæsthesia had worn off.

(4) The drainage of the intestine through an enterostomy tube proximal to the anastomosis (in this case proximal to the proximal anastomosis) I believe is a very important point and should be done in all operations of intestinal resection where previous drainage of the intestine has been impossible. An enterostomy properly done, using a No. 16 to 18 catheter, immediately removes the accumulated toxic content of the obstructed bowel and in the first few post-operative days prevents distension and prevents any strain on the line of anastomosis. When the bowels begin to move normally the tube can be clamped off part of the time, opened if any distension occurs, and removed after it is demonstrated that the anastomosis is working without difficulty.

**CASE REPORT.**—A woman, aged eighty-three years, was first seen March 5, 1932, on account of abdominal pain and vomiting. She had been subjected to hysterectomy twenty years ago for uterine fibroids. There was complete recovery following. Twelve hours before she was seen by me she was seized with severe abdominal pain which came on suddenly, accompanied by severe nausea and vomiting. This pain was at first intermittent in character and throughout the lower abdomen. When first seen there was considerable abdominal distension present. The pattern of the small intestine was plainly visible

## STRANGULATION OF TWO LOOPS OF INTESTINE

through the thin abdominal wall but no peristaltic movements were seen, even after tapping the abdomen. The entire abdomen was tender with moderate muscle spasm of both lower recti muscles, and the intestines had a soft doughy feel but no masses were felt.

It was quite evident that the patient had an intestinal obstruction, which apparently at first was mechanical but which had progressed to the paralytic stage.

She was sent to the Emergency Hospital and was operated upon shortly after her arrival there. Pre-operatively she was given 500 cubic centimetres of 5 per cent. glucose intravenously, as well as the usual pre-operative dose of morphia.

The operation was done under spinal anaesthesia using 150 milligrams of neocaine.

The abdomen was opened through the previous scar in the lower mid-abdomen; the peritoneal fluid was dark blood-tinged and the presenting small intestines were dark and gangrenous. This gangrenous bowel was found to be ileum which had become strangulated due to an adhesion extending from the terminal ileum to the posterior parietal peritoneum in the region of the promontory of the sacrum. When this adhesion was severed, making it possible to deliver the gangrenous intestine, it was found that there were two separate loops of gangrenous small bowel, each about eighteen inches in length with about three feet of normal intestine between them. The distal gangrenous loop extended upward from the ileocecal junction for a distance of approximately eighteen inches and the proximal gangrenous loop began about three feet above this and was of about the same length.

The intervening bowel between the two gangrenous loops was normal except there was a well-developed Meckel's diverticulum three inches in length which was not involved in the present picture. There was considerable thrombosis of the mesenteric vessels supplying the areas of gangrenous intestine but there was no thrombosis of the vessels of the remaining mesentery.

Both loops of gangrenous intestine together with a wide margin of normal intestine on either side, as well as a deep wedge of the mesentery, were resected and an end-to-end anastomosis done at the proximal resection, and an end-to-side—that is, end of the ileum to the side of the caecum—done at the distal resection, the latter being done with a Murphy button. A temporary enterostomy using a No. 16 catheter was done just proximal to the proximal anastomosis, and the abdomen closed without drainage, bringing the enterostomy catheter out through a stab wound in the right lower quadrant. The double resection was done as quickly as possible and the Murphy button was used in the one anastomosis on account of the time element.

The patient showed no great amount of shock during the operation and left the operating room in excellent condition. She was given glucose and salt solution in large amounts, both intravenously and subcutaneously, during the first week, and during this first week she received very little by mouth except small amounts of water. There was no distension, no vomiting of any account, and the post-operative course was entirely uneventful. Beginning the sixth day, olive oil was instilled in the rectum, four ounces at a time, and on the seventh day patient began to have spontaneous bowel movements. The drainage from the enterostomy tube stopped as the bowels began moving normally and the catheter was removed on the tenth day.

The Murphy button was not passed at the twelfth day and at this time on digital examination of the rectum it was found in the rectum and easily removed. Except for some troublesome diarrhoea the patient made a smooth recovery and left the hospital in three weeks. At the time of leaving the hospital she was up in a chair most of the time and felt quite well. Since leaving the hospital she has continued to improve and has fully regained her former strength and vitality.

JOSEPH P. SHEARER, M.D.,  
*Washington, D. C.*

## INTUSSUSCEPTION THROUGH GASTROENTEROSTOMY STOMA

**CASE REPORT.**—A woman, aged thirty-five years, had been the subject of three laparotomies, including posterior gastroenterostomy in October, 1923. Relief complete and constant until September 7, 1930, on which date at 2 A.M. she was awakened by severe pain in upper abdomen; unrelieved by moderate doses of morphia; after some hours marked symptoms of shock developed; abdomen not distended, tender or tympanitic; admitted to St. Joseph's Hospital where the abdomen was opened by a high incision to the left of the umbilicus. The exposed stomach was greatly distended by the distal portion of jejunum, five feet of which had invaginated through the stoma of the gastroenterostomy. The invaginated bowel was easily withdrawn. It was œdematosus, somewhat discolored but yet glistening. It was evident that gangrene had not yet supervened. The stoma would admit three fingers. It was reduced to about one-half this size by interrupted mattress sutures placed on the stomach side of the opening. Prompt and rapid improvement followed the removal of the incarcerated bowel from the stomach. Wound healing uncomplicated. While the immediate results of the operation were satisfactory, there have been later, on a number of occasions, attacks varying in duration and intensity of nausea, vomiting and pain in the upper abdomen. These attacks have always been associated with obstinate constipation. They have, to date, yielded promptly to conservative measures.

*Remarks.*—In 1922, Lewisohn, *ANNALS OF SURGERY*, LXXVI, pp. 543-545, October, 1922, in reviewing this subject and reporting a case of his own, directed attention to the extreme rarity of the condition, stating that "in forty years of gastroenterostomy, a similar case has not been reported." Subsequent observations have shown, however, that intussusception of the small intestine into the stomach through a gastroenterostomy stoma is not an infrequent complication. The condition may sometimes correct itself. In other words, all cases may not come to operation or autopsy. See article by Shearer and Pickford, *ANNALS OF SURGERY*, LXXXVII, pp. 574-577, April, 1928, being a report of twenty-four cases.

NICHOLAS SCHILLING, M.D.  
*New Hampton, Iowa.*

## JEJUNOSTOMY

AN EXPERIMENTAL STUDY IN A PERMANENT NON-LEAKING  
YET CLOSABLE TYPE

A TERMINAL loop of jejunum is delivered through a small transrectus incision (left preferable). At the base of the loop as shown in Fig. 1 a side-to-side anastomosis is done—the opening being about one and one-half inches in length. The anastomosis is done without interference with the mesentery of the bowel and about three-eighths of an inch from its attachment to the bowel.

Midway between the concavity of the anastomosed loop and the upper limit of the enterostomy the lateral wall of the bowel is inverted after scarification of the serosa for a distance of three-fourths inch and sutured as shown in Fig. 2EB and Fig. 4. This acts as a valve structure, the function of which is to prevent retrograde leakage. Experimentally it has been found that it is unnecessary to make a bilateral valve and that as a rule the valve at the distal part of the loop X at point E is sufficient. The reason for this is that peristalsis in the distal portion of loop (X) is toward the opening D, while in loop Y the peristalsis is away from opening D.

## JEJUNOSTOMY

An opening D is made in summit of convexity of loop (X-Y) and along 25 French catheter or duodenal tube is passed in loop Y beyond point of anastomosis and fixed by purse string at point D. This allows of feeding patient without interfering with operative areas either externally or internally.

At point C the convexity of the loop is sutured to the peritoneum-rectus sheath and skin so that almost one-half inch of loop protrudes above the skin; the abdominal wound is closed in the usual way.

Figure 3 gives a diagrammatic representation of the mechanism of this type of jejunostomy. The tube (F) allows of immediate feeding to distal loop Y, without interfering with any of the areas operated. This allows of healing with safety of the entero-enterostomy and the external jejunostomy. After a period of eight to ten days this tube is removed and a tube can be introduced just beyond the opening D without regard to which loop the food is injected since the anastomosis retains the proper flow and continuity of the bowel. The anastomosis besides this prevents leakage of important duodenal contents. The valve E alone or E and B further insure non-leakage.

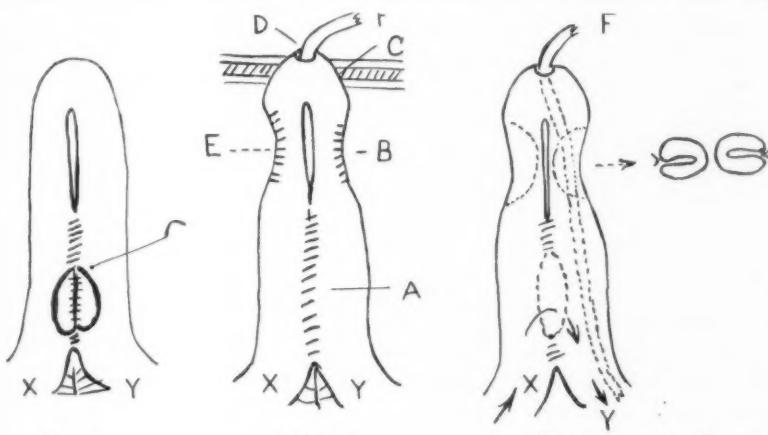


FIG. 1

FIG. 2

FIG. 3

FIG. 4

As can be readily seen one can make this type of jejunostomy as permanent as one desires and yet can readily be closed without fear of necessity for extensive operation to restore the continuity of the bowel. To close simply tamponade or suture hole D.

On the dog this type of operation was done very rapidly under local anaesthesia without any untoward effects, no leakage or excoriation of skin, and the dogs lived under laboratory conditions for months. In one case the duodenum was used for the above technic, the dog living without leakage for months.

The opening D can be made in various ways, as, for instance, as in Bloodgood's technic for side-to-side anastomosis of the intestine leaving one loop patent or suture of mucosa of jejunum to skin as in the Janeway gastrostomy.

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## BOOK REVIEW

**SURGICAL PATHOLOGY.** By ARTHUR E. HERTZLER, M.D. 8 vo.; 4 vols.; Cloth. J. B. Lippincott Co., Philadelphia, 1931.

Thus far the author has prepared four monographs consisting of his observations during the past thirty years both as a teacher and as a general surgeon in the fields of the surgical pathology of the (1) Diseases of Bones; (2) Skin, Blood-vessels, Muscles and Nerves; (3) Genito-urinary Organs; and (4) Female Generative Organs. As he states, the subject matter represents essentially his personal viewpoint on the various pathological conditions found and therefore may be found at variance with the conclusions of other qualified observers whose interpretations of certain conditions have perhaps been accepted more widely as being correct.

The material presented is considered under three heads, namely, Pathogenesis, Pathology and Histology, the first linking up the pathology with the clinical aspects; the second depicting what the surgeon sees and feels, including the physical findings and gross pathology, and the final section includes just enough of the finer anatomy to make the gross pathology more intelligible.

The volumes thus far published represent certainly an enormous amount of very carefully correlated labor extending now over three decades, which naturally is of far greater value to the observer personally than to the reader. The experience gained by the very apparent careful evaluation of such an extensive material must indeed be a source of great satisfaction to its possessor. The difficulty of attempting to transmit it to others is practically insurmountable. However, in so far as this is possible, it has been accomplished by the author. The lucidity and succinctness of its presentation is quite exceptional. The illustrations, which average 245 in each of the four volumes, are very excellent and reflect credit on the photographer of these most difficult objects. The monographs average 291 pages each, which makes a volume easy to handle.

To the thoughtful surgeon and much more so, to the younger generation, a most careful study of these exceptionally well-presented studies of the innumerable aspects of surgical pathology must prove of very great aid and benefit not only to them but also in the interest of the patient.

JAMES T. PILCHER.

### EDITORIAL ADDRESS

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